THE TELEGRAPHIC JOURNAL AND

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INSULATORS.

ALTHOUGH but little has been done within the last few years in the direction of improving the insulation of ærial wires, it can hardly be admitted that there is no room for improvement. In this country, especially, where moisture is so prevalent, the loss which occurs on the best insulated lines is very considerable, and any decided departure for the better from the existing patterns of insulators would prove a source of considerable profit to the inventor. Whatever the improvement may be, however, it must not be one which would add materially to the cost of the present forms, or the chance of its use would be small.

Insulator manufacturers, we are inclined to think, pay too much attention to the quality of the body of the ware of which the insulator is formed. If great mechanical strength, with a highly glazed and uniform surface can be obtained with a comparatively low class body, there is no reason why the latter should not be used. The insulating value of an insulator is practically entirely dependent upon the excellence of the surface and not upon the mass, as the normal leakage which takes place is superficial entirely. Owing to the fact that the ware must have a resting place in the baking kiln, it is usually the case that that portion which touches the rest does not become coated with glaze. We frequently find that the position of rest is such that the most important part of the insulator, namely, the "lip," is left bare, whilst the "crown," where a glazed surface is totally unnecessary, presents a highly finished surface. Length compared with small diameter would seem to be the correct form for an insulator, but practice does not confirm this; not, however, because the normal leakage is great, but because of the great difficulty of keeping the insulators internally clean and free from the webs which spiders can spin so freely in a confined space. Many attempts have been made to increase the length of the external surface over which leakage can take place, by a system of corrugating; such an arrangement, although no doubt efficient in the case of new insulators, is liable to harbour dirt, and thus to eventually reduce the efficiency below that of the plainer patterns.

A great deal has been said with reference to the method of securing the line wire to the insulators as regards its effect upon the insulating capacity of the same; experience has, however, amply proved that, whether the line wire touches at a mere point, or is secured to the insulator by folds of binding wire, yet the difference in the two cases is very slight.

Telephony.—Orders have been issued that telephones for the use of divers are to be supplied to Her Majesty's ships carrying such men.

ON THE HEATING EFFECTS OF ELECTRIC CURRENTS.*

By WILLIAM HENRY PREECE, F.R.S.

THE production of heat in electrical conductors due to the transference of electricity through them has become a matter of very great practical importance. A knowledge of the variation of the law, due to the dimensions and character of the conductor, is essential for lightning protectors and for the leads of electric lights.

Atmospheric electricity has proved a great danger to insulated wires, subterranean and submarine, and to telegraphic apparatus generally. Not only do the direct discharges of atmospheric electricity enter the wires, but very powerful currents are induced in neighbouring wires when these discharges take place, either between cloud and cloud or between cloud and earth. Various plans have been devised to protect apparatus and wires from these currents. Lightning protectors based on the effect of points, on the facility of discharge through vacua, on the low resistance of thin air spaces to high potential, and on the fusibility of thin wires, have been used.

The most careful and long-continued observations have shown that the survival of the fittest is found in the use of a thin flat air space, A (fig. 1), supplemented by a fine well-insulated protecting wire, B, of high resistance, wound around a brass rod in connection

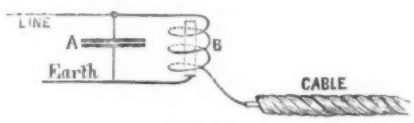

Fig. 1.

with earth. The air space is obtained by superposing two smooth plane surfaces of thick brass, separated from each other by a space of ·004 of an inch, by means of a frame of mica or paraffined paper. It requires (according to the researches of Messrs. Warren De La Rue and Hugo Müller†, confirmed by my own observations made in Dr. Warren De La Rue's laboratory) a potential of 800 volts to strike across such an air space, and when this is done a path of no resistance, according to Faraday, is established for the atmospheric discharge to flow to earth. But destructive currents of induction are often produced in telegraph wires, which have not the requisite potential to strike across this air space, and the element of *time* may enter to force some of the current into the cable or apparatus so as to injure it. Hence a protecting wire has been added, which, while it will allow all working currents to pass without retardation, will not allow a current strong enough to damage the cable to flow through without its being fused. It thus acts as a safety valve. The length and dimensions of this wire have not been hitherto determined by any stringent conditions. After having determined the conditions required to give the maximum effect with the so-called "plate protector,"‡ I became anxious to find out the conditions that would give a similar result with the "wire protector."

Now, the very strongest current that can, under any possible circumstances, enter a wire from the working batteries is one of 500 milliampéres (·5 B.A. unit current) while atmospheric currents enter the wires of all strengths from 1 milliampère to 30 or 40 ampères, or even more. Therefore, it was desirable to find that wire which would not fuse with 500 milliampères, but would fuse with currents of about 700 milliampères and over.

Hence, I took a source of electricity, which was a large thermopile of Clamond's make, which would

* Read before the Royal Society, March, 1884.
† *Phil. Trans.*, Part II., Vol. 174.
‡ British Association, 1880.

give the necessary current, a rheostat by which it was possible to regulate this current to any strength, a Thomson mirror galvanometer, which enabled me to measure, record, and regulate every change of current, and a discharger, by which I was able to hold, measure and adjust the wires to be tested.

1. With a given current and a uniform wire of given diameter and given material, the effect, allowing for the cooling effect of the binding screws, was independent of the length, for whether the length experimented upon was an inch, a foot, or a yard, it always fused when the current reached a certain definite strength. The point of fusion was irregular, for it simply depended on some irregularity in the uniformity of the wire, and the weakest link in the chain went.

2. Samples of platinum wire of various diameters, each of 6 inches in length, were taken, and the current increased gradually until the wire fused. The results are given in the following table :—

Diameter in inches.	Fusing current in ampères.
·00050	·277
·00075	·356
·001	·437
·002	·790
·003	1·150

The above figures are the average of numerous experiments, and they are plotted out in fig. 2.

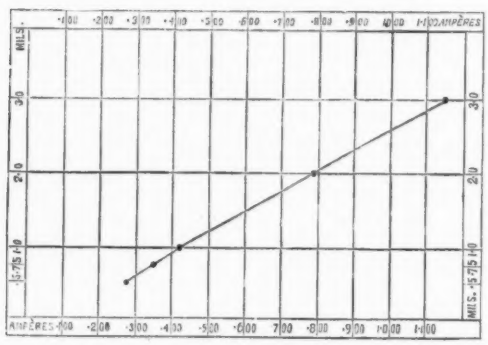

FIG. 2.

The general law governing the ratio between the current strength and the diameter of the wire when the latter is raised to a definite temperature, and where radiation is free and unchecked by any athermanous envelope, appears to be that the current should vary as the diameter $\times \sqrt{\text{diameter}}$;* this may be proved as follows :—

The heat developed in any cylindrical wire is by Joule's law—

$$H = C^2 R t,$$

where

$$R = \frac{2 a l}{\pi d^2}$$

a being the specific resistance, l the length, and d the diameter of the wire, then—

$$H = C^2 . \frac{2 a l}{\pi d^2} . t = \mu \left(\frac{C}{d} \right)^2;$$

Or, if we maintain the ratio between the current and the diameter constant, the same amount of energy will be wasted in the conductor.

But the temperature of the conductor is dependent on the rate at which the heat is radiated and conducted away, and when the heat imparted by the current just balances that lost by radiation and convection, the temperature becomes constant. But the heat lost varies with the surface, and the smaller the surface the less the loss, and therefore the temperature will vary with the diameter. Hence as—

$$H \propto \left(\frac{C}{d} \right)^2,$$

and also

$$H \propto d$$

therefore $\frac{C^2}{d^2} = d$, or, $C = d\sqrt{d}$.

The results of the foregoing experiments on the currents required to fuse wires of different diameters would appear to contradict this law, and to show that the current varies as the diameter, but there are several elements in the method of making the measurements which tend to modify the general law. Platinum wires—especially those of small diameter—are liable to flaws which practically reduce their effective diameter to a great extent ; also the larger wires from their greater weight necessarily tend to part asunder at a lower temperature than those which are lighter and on which the strain is less.

3. In thermometric measurements there are only two fiducial points usually employed, viz., the freezing point, and the boiling point, but there are two other points equally well marked, though, perhaps, not quite so accurately fixed. These are the points of self-luminosity and of fusion. The first point has been determined by Daniell to be $\left\{ \begin{matrix} 980° \text{ F.} \\ 526°{\cdot}6 \text{ C.} \end{matrix} \right\}$, and by Draper at $\left\{ \begin{matrix} 977° \text{ F.} \\ 525° \text{ C.} \end{matrix} \right\}$, and it has been shown by the latter observer that this is true for all substances.

I was anxious to discover whether the law before stated would apply in the case of the production of the lowest visible red radiations by currents. I therefore took several wires of different materials, and of different diameters, but all of the same length, and by observing them in a carefully constructed dark chamber, determined the currents that produced self-luminosity, these currents being measured by finding the difference of potential at the ends of a thick German silver wire, R, whose resistance was ·0157Ω, inserted in the same circuit. The results of the experiments, which were very carefully made, are given in the following tables :—

Constant deflection from standard Daniell cell = 9050′ (d) through 10,000 ohms.

$$C = \frac{1{\cdot}07}{d \times R} \times D.$$

Description of wire.	Gauge of wire in mils.	Area per square inch.	Deflection.	Shunt.	Resistance in coils.	Resistance of shunted galvanometer.	Total resistance.	Equivalent deflection through 10,000 ohms (D).	Observed current in ampères.	Current calculated from the formula ·14387 × $d\sqrt{d}$.
Copper.	30	·0007066	285	$\frac{1}{10}$	1,000	512	1,512	4309	23·969	23·969
	24	·0004523	212	$\frac{1}{20}$	10,000	5121	15,121	3026	16·832	17·151
	20	·0003141	163	$\frac{1}{20}$	10,000	5121	15,121	2465	13·711	13·047
	18	·0002544	134	$\frac{1}{20}$	10,000	5121	15,121	2026	11·269	11·140
	14	·0001539	91	$\frac{1}{20}$	10,000	5121	15,121	1376	7·654	7·641
	8	·0000502	113	$\frac{1}{20}$	1,000	5121	6,121	692	3·849	3·300

Constant deflection from standard Daniell cell = 9050′.

Description of wire.	Gauge of wire in mils.	Area per square inch.	Deflection.	Shunt.	Resistance in coils.	Resistance of shunted galvanometer.	Total resistance.	Equivalent deflection through 10,000 ohms.	Observed current in ampères.	Current calculated from the formula ·65755 × $d\sqrt{d}$.
Swedish wrought iron.	60	·0002827	330	$\frac{1}{20}$	2000	5,121	10,121	3340	18·379	18·379
	40	·0012?6	345	0	30·0	51,210	36,210	1939	10·785	10·113
	20	·0 00141	137	0	5000	51,210	36,210	770	4·283	3·575
	10	·0000783	55	0	5000	51,210	36,210	309	1·718	1·427

* The ELECTRICAL REVIEW, June 24th, 1882, page 454, and Prof. George Forbes, B.A., 1882.

Constant deflection from standard Daniell cell = 9050′.

Description of wire.	Gauge of wire in mils.	Area per square inch.	Deflection.	Shunt.	Resistance in coils.	Resistance of shunted galvanometer.	Total resistance.	Equivalent deflection through 10,000 ohms.	Observed current in amperes.	Current calculated from the formula $·05576 \times d\sqrt{d}$.
German silver.	25	·0004908	207	$\frac{1}{9}$	1,000	5,121	6,121	1267	7·047	7·047
	20	·0003141	150	$\frac{1}{9}$	1,000	5,121	6,121	918	5·106	5·042
	16	·0002010	115	0	10,000	51,210	61,210	704	3·916	3·608
	14	·0001539	110	0	10,000	51,210	61,210	673	3·743	2·935
	8	·0000502	37	0	10,000	51,210	61,210	226	1·257	1·276

Constant deflection from standard Daniell cell = 12,252′.

Description of wire.	Gauge of wire in mils.	Area per square inch.	Deflection.	Shunt.	Resistance in coils.	Resistance of shunted galvanometer.	Total resistance.	Equivalent deflection through 10,000 ohms.	Observed current in amperes.	Current calculated from the formula $·057465 \times d\sqrt{d}$.
Platinum.	38	·001134	121	$\frac{1}{10}$	1000 + 488	512	2000	2420	13·461	13·461
	20	·0003141	123	" "	488	512	1000	1230	6·841	5·140
	18	·0002544	104	" "	488	512	1000	1040	5·785	4·380
	14	·0001539	142	" "	88	512	600	852	4·739	3·010
	11	·0000950	100	" "	88	512	600	600	3·337	2·097
	8	·0000502	76	" "	88	512	600	456	2·536	1·500

The results are plotted out in fig. 3. It will be seen that the observed and calculated results agree to a considerable degree of accuracy except in the case of

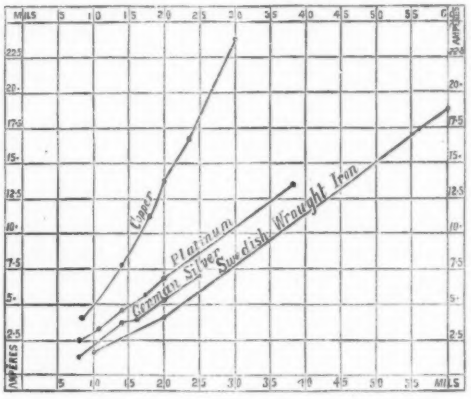

FIG. 3.

platinum, which behaves as in the previous experiments, and is generally found to be irregular in its quality.

These experiments were made upon wires exposed to the air, where radiation is free. I am anxious to repeat them upon wires covered in insulating material and buried in the ground, but I have not been able to do so up to the present moment. The law with reference to such wires has a very important bearing on the size of electric light leads, for it shows the necessity of making them large enough to prevent the possibility of their being heated above normal temperatures, otherwise points of danger are very easily reached by increments of current.

THE LATE ELECTRICAL EXHIBITION AT THE CRYSTAL PALACE.

(*Continued from page* 306.)

Method of Testing the Incandescent Lamps.—A current from a Grove's battery was sent through the lamp to be tested and the current-meter in simple circuit, the lamp being in its place on the Bunsen photometer. Wires were carried from the two electrodes of the lamp to the key employed for discharging the condenser through the reflecting galvanometer, and wires from the same electrodes were also connected to the voltmeter. The positions for the equality of illumination in the photometer were found for red light and for green light by looking at the photometer through red and green glasses respectively. The illuminating power of the standard lamp with which the incandescent lamps were compared was determined to be 17·5 candles. At first a set of observations was made simultaneously by the different observers with, say, 20 cells of Grove, then 5 cells more were added and the observations repeated, then 5 cells more, and so on up to 40 or 50 cells, or higher. In some cases experiments were carried to the breaking point, or giving way of the lamp, when it was found that the lamps of each maker had their own distinctive peculiarity. By making the tests in this way we were able to determine the characteristic, and to plot the characteristic curve for each lamp—a curve in which the energy absorbed is measured horizontally, and the candle-power measured vertically.

The values of $\frac{E}{C}$, or the resistances of the lamps, show clearly that there is a point which is reached in the case of the Edison lamps when their resistance diminishes no further, but begins to increase as the current increases. If we draw the curve with the current for the abscissa, and the E.M.F. for the ordinate, we see where the resistance begins to increase by a change in the direction of curvature of the curve. Probably at this point the carbon filament begins to give way at the junction with the copper, for it is generally found that this is the point which first yields in the Edison lamps. In the case of the Swan lamps this critical point was not reached, and the curvature continues to be in the same direction to the extreme point tested.

The characteristic curve for the Edison B lamps shows that at 10 candle-power the Edison lamp yields 150 candles per horse-power. As the illumination is increased the yield increases. At 16 candle-power there are 5·7 kilogrammetres and 211 candles per horse-power. At 32 candle-power there are 7 kilogrammetres and 342 candles per horse-power. At 40 candle-power 7·5 kilogrammetres are absorbed, and there is a yield of 400 candles per horse-power. Comparing this with the Swan lamps, we see that an absorption of 7·5 kilogrammetres gives 60 candle-power in each lamp, and a yield of 600 candles per horse-power. The characteristic curve for the Swan lamps shows that at 10 candle-power there is a yield of 200 candles per horse-power. At 16 candle-power there are 4·4 killogrammetres absorbed, and a yield of 272 candles per horse-power. At 32 candle-power there are 5·8 kilogrammetres absorbed, and a yield of 415 candles per horse-power. I have employed these numbers for the sake of comparison with the results arrived at in Paris* by Professor G. F. Barker and Mr. Crookes. As might be expected, the economy of all incandescent lamps is greater at high than at low incandescence. This might be expected, since there must be a certain quantity of energy used up in the radiation of dark heat from the carbon filament, when the temperature is not high enough to make it glow, and this dark heat is not increased so greatly in amount when the filament has reached the temperature at which it gives a brilliant light. The comparison of the characteristic curves of Swan high-resistance and low-resistance lamps with Edison B lamps does not seem to support the statement that "the economy of light production is greater in high-resistance than in low-resistance lamps;" for the economy of Swan No. 13, whose resistance cold is 194 ohms, and Swan No. 16, whose resistance cold is 20 ohms, are very nearly the same, the curves crossing one another; and both of these are more economical than the Edison B lamp, whose resistance cold is 136 ohms.

These experiments clearly show that the economy of

* See ELECTRICAL REVIEW for June 17th, 1882.

light-production is not necessarily greater in high-resistance than in low-resistance lamps, but is rather a function of the material of the filament, and the way in which that filament is made. Swan's 200 ohm and his 20 ohm lamps are shown to be nearly equal in efficiency, the resistance of the first when giving an illumination equal to that of 37 candles being 102 ohms, and of the second less than 10 ohms. The other low-resistance lamp, which is nearly of the same efficiency and more efficient than any of the Edison lamps, or of the lamps of other inventors, has a resistance of about 13 ohms when giving the same illumination of 37 candles.

These results show that the question of constructing incandescent lamps of high or low resistance must be decided entirely by the economy of distribution of electricity. In the case of the high-resistance lamp, the current for 37 candles is only about three-fourths of an ampère, whereas the current for the same illumination from the low-resistance lamps is at least three times as great, or $2\frac{1}{4}$ ampères.

Transmission of power by dynamo machines.—We have still to consider the reconversion of electrical energy back into mechanical work by means of a motor dynamo machine. If two dynamo machines be placed on the same electric circuit, and one of them be set in motion to generate a current of electricity, part of the energy of the current will be spent in heating the conductor throughout the circuit, and another portion will be spent in setting the other dynamo in motion in such a direction as to produce an opposing electromotive force in the circuit.

The previous equations for dynamos are modified, and the extension of Ohm's laws gives $\mathrm{E} = e + \mathrm{C}\,\mathrm{R}$, where e is the opposing electromotive force of the motor dynamo, and R the total resistance of the circuit. We have also the equation $\mathrm{E}\,\mathrm{C} = e\,\mathrm{C} + \mathrm{C}^2\,\mathrm{R}$ connecting the different portions of the electrical energy. Here e C is the number of units of electrical energy which may be converted into mechanical work by means of the axle of the motor dynamo. The ratio, $\frac{e}{\mathrm{E}}$, may be termed the electrical efficiency of the combination. The equation $e = \mathrm{E} - \mathrm{C}\,\mathrm{R}$ shows that for the same electromotive force of the generator, *i.e.*, for the same rate of revolution, the contrary electromotive force of the motor, and consequently the speed of the motor, diminishes as the resistance of the circuit increases. The effective work, e, C is greatest when $e\,\mathrm{C} = \mathrm{C}^2\,\mathrm{R}$, *i.e.*, when the electrical efficiency, $\frac{e}{\mathrm{E}}$, is $\frac{1}{2}$, *i.e.*, when one dynamo revolves at half the speed of the other, supposing the dynamos to be alike.

The electrical efficiency will then be the ratio of the rates of revolution. So much progress has been made in the reconversion of electrical energy into mechanical energy, or energy of motion, during the past year, that I must include some notice of it in my address.

The use of dynamo machines for the transmission of power to considerable distances has now been accomplished, the loss in converting electrical into mechanical energy being no greater than in the reverse action. Electrical and mechanical energy being two modes of the energy of motion, which are mutually convertible, the only loss is that due to friction and the heating of the wires. We have seen that the external or commercial efficiency of the best dynamo machines is 88 or 89 per cent.—say, 88 per cent. Taking the same efficiency for reconversion, the twofold conversion may be effected with an efficiency of 77·5 per cent. *i.e.*, with a loss of 22·5 per cent. But the conductors will absorb some energy as heat through their electrical resistance, the amount depending on the length of the conductors and on the current which they have to carry, *i.e.*, upon the work which the motor is required to do; allowing 5 per cent. for this will still leave a mechanical efficiency of 72 per cent.

Visitors to the Electrical Exhibition in Paris cannot fail to have been struck with the great variety of applications of electrical energy which had already been made by M. Marcel Deprez, and they will not have been astonished at the later results at Munich, again at Paris at the Chemin de Fer du Nord, and the much greater success attained within the last few months at Grenoble.

The objections which were urged with regard to the two machines in the experiments at the Chemin de Fer du Nord, in Paris, that they were placed close together, can have no place in the Grenoble experiments, where the dynamo machines were placed 14 kilometres, or nearly 9 miles, apart. In these experiments wires of the new material, *siliceous bronze*, of 2 millimetres diameter, were employed as the conductors, and greater attention was paid to the insulation of the two machines. The power was applied to the generating machine from a turbine, and was measured from time to time by means of a Prony friction-brake, the velocity of the turbine being the same as in the running of the dynamo machine.

As one result of the experiments carried out at Grenoble it has been shown, experimentally, that the efficiency increases with the velocity of rotation of the generating machine (as the formula

$$\rho = \frac{1}{1 + \frac{\mathrm{R}}{n\,(a + b\,m + c\,m^2)}}$$

would give). These experiments have also shown an electrical efficiency of from 60 to 70 per cent., corresponding to a commercial or mechanical efficiency of conversion of from 50 to 62·3 per cent.

In these experiments the velocities of revolution were so high that the magnetic fields of the machines were near their points of saturation, and so might be regarded as no longer varying with the current.

The opening of the Portrush electric railway in September last, and its practical working, show that in our own country Sir William Siemens has not been behind in the practical applications of electrical energy. A separate conductor is placed at the side of the railway to carry the current, the return circuit being completed through the rails themselves. The power is obtained by means of turbines from a waterfall with a head of 24 feet. The electrical conductor is maintained at an electromotive force of 225 volts. The resistance of the conductor per mile is ·23 ohms; and, with four cars running, requiring 4 horse-power each, the loss due to resistance does not exceed 4 per cent. of the power developed on the cars. In his paper on this railway, Mr. A. Siemens has shown the use which may be made of characteristic curves of dynamos, when the object is to find what arrangement of dynamo machines is best adapted to perform any given work.

We see, then, that by means of the dynamo machine mechanical work may be converted into electrical energy, and that in the form of the electric current as much as 88 per cent. of the total energy expended can be usefully employed in the external electric circuit in producing heat (as in the electric furnace) or light (as in arc and incandescent lamps). Or this energy may be conveniently transmitted to a distance from its source, and may then be converted back into mechanical work, giving out again more than 60 per cent., or even 70 per cent., of the mechanical work originally spent in its production.

(*To be continued.*)

THE ELECTRIC TRANSFER OF ENERGY.

RESEARCHES OF M. MARCEL DEPREZ.

Summary of Experiments.

By FRANK GERALDY.

Translated from *La Lumière Electrique.*

(*Continued from page* 312.)

As it was necessary to know exactly all the circumstances, and to take as many measurements as possible, M. Marcel Deprez made the most suitable arrangements to facilitate such studies. To this end the two machines, the generator and the recipient, were placed

near each other in the work-rooms of the company, connected on the one hand by a wire of trifling resistance, and on the other hand by a double telegraphic line going to Bourget and returning. The distance was 8·5 kilometres, and the total length of the wire about 17 kilometres. Of the two machines, the one which served as generator was the dynamo recently constructed, of which we give a representation in fig. 8.

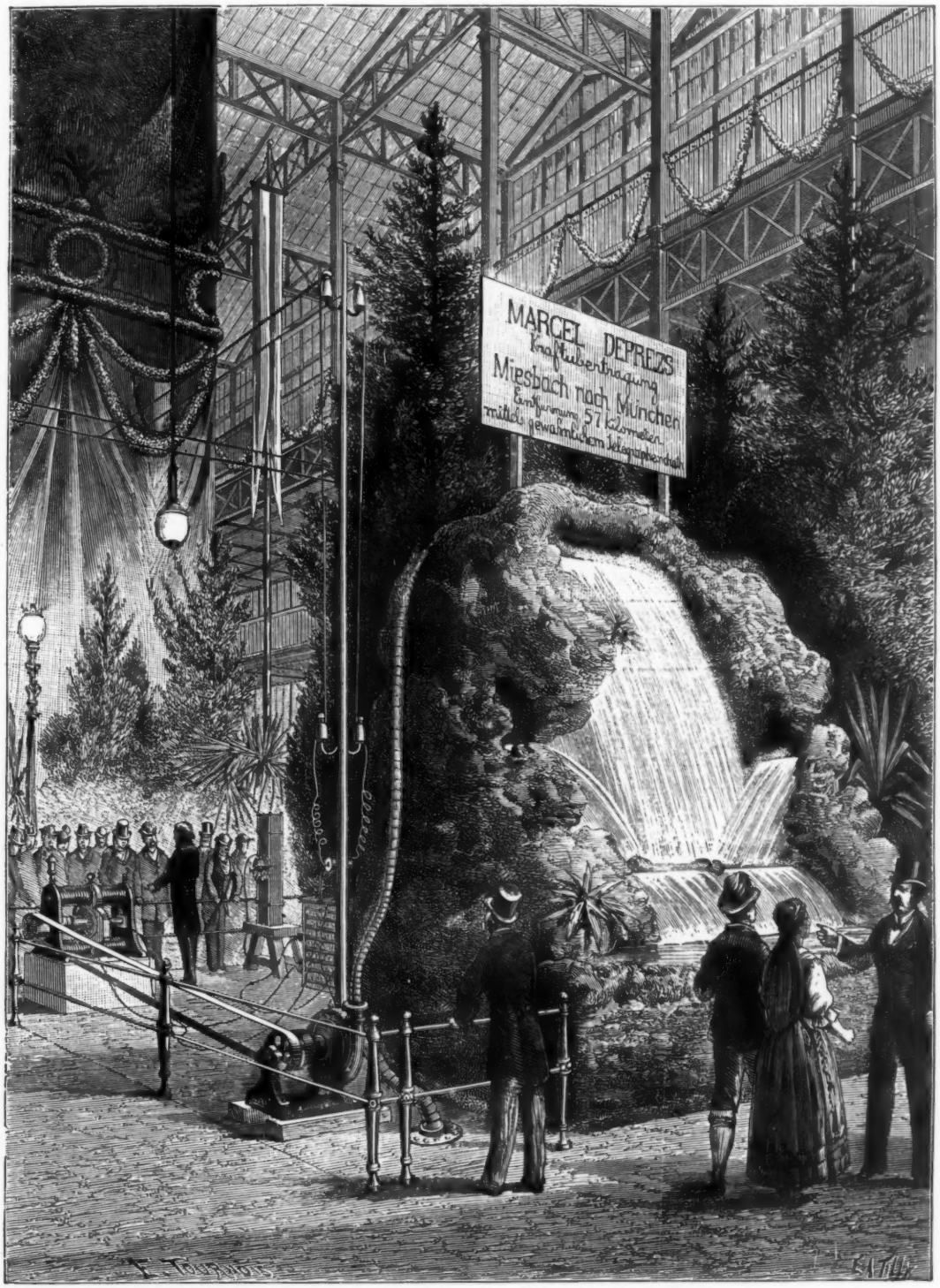

Fig. 7.—Installation at Munich.

As will be seen, this machine has two induced rings, each turning in a distinct magnetic field. The inductors have the form of horseshoe electro-magnets, which has been found the most advantageous to produce the magnetic field with a small outlay of energy. The numerous terminals on the upper table are intended for effecting combinations, and for modifying the effects of the machine, which was thus adapted for study and experiment. The recipient was a Gramme machine, of the model, D, transformed. It was not unknown that this machine was inferior to the other, but we must add that the experiment was attended with all sorts of unfortunate circumstances. The recipient had suffered in recent experiments; the days for the experiment being fixed, there was no time for repairing it, and it had to be taken away as it was, with full knowledge that it was faulty in several places, but to what extent was not entirely known. To crown all, the generator, which was in very good condition, was drenched in a heavy shower whilst being taken down from the truck. It was thought at first that the damage was slight, but it had to be taken into account. To gain its electromotive force, this machine had to be revolved at a velocity of 1,000 to 1,500 revolutions. When set in motion, it was impossible to bring it to more than 500

revolutions. At this speed the insulators, soaked in water, allowed the electricity to pass, and sparks flew off continually. It was necessary to begin under these wretched conditions, and it was only by degrees, as the machine dried slowly, that it was possible to attain proper velocities. Still 1,000 revolutions, which ought to be a normal velocity easily exceeded, remained a maximum, on the subject, and nominated a Commission, composed of M. Bertrand, the perpetual secretary, as president, and MM. Tresca, De Freycinet, De Lesseps, with Cornu, as reporter.

The work expended at the generating machine was measured by means of a Morin transmission-dynamometer, obligingly lent by the Commission of Arts and Trades. The work received was

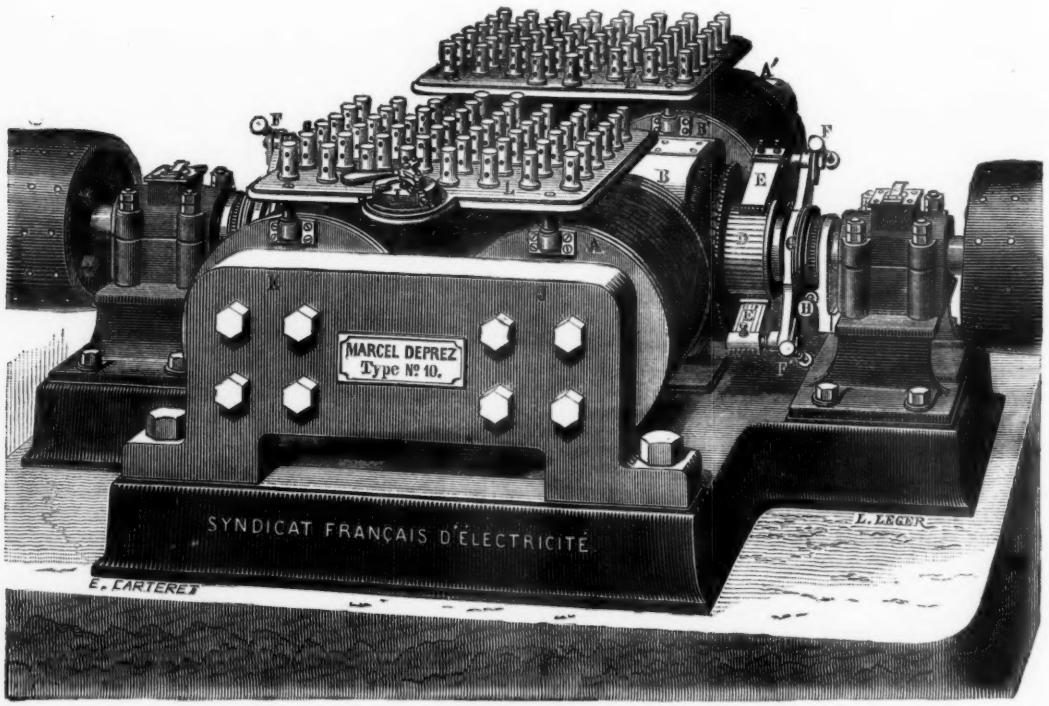

FIG. 8.

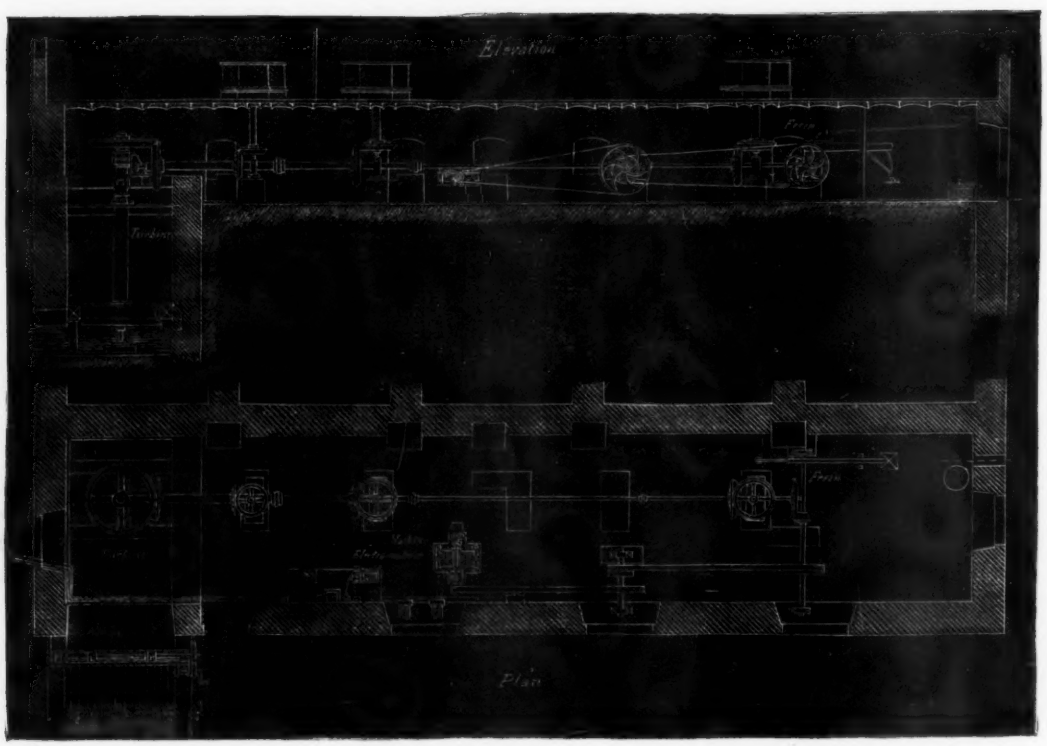

FIG. 10.

which was not reached without difficulty, and which could not be kept up for any length of time. These experiments introduced quite a new feature into the question of the electric transmission of power. They attracted very strongly the attention of the scientific world, so much so that the Academy of Sciences, to whom communication had been made, wished to be completely enlightened absorbed and measured by a Prony brake. The electric elements were determined in duplicate by M. Cornu with Deprez galvanometers, and by Dr. Hopkinson with the instruments of Sir William Thomson.

It must be added that these instruments had had to be arranged in a special manner to measure very high potentials, for which

they had not been constructed, and for which, indeed, no apparatus exists. Thus the Deprez galvanometer acted in a circuit into which a resistance of 50,000 ohms had been introduced. All the details, and the procedures for gauging and verifying are explained with great care in the report made to the institute by M. Cornu, and have appeared in the *La Lumière Electrique* (April 14th, 1883). A series of experiments was made at different velocities, and the following values were obtained (see following table, extracted from the report). Among these experiments, one, No. 5, might be the subject of a certain doubt. This experiment was marked by an accident, fortunately unattended by serious results, but which greatly alarmed the observers. Whilst taking electric measurements, M. Cornu, wishing to move the commutator, grasped it by mistake by the metal instead of by the insulating handle, and thus found himself in a derived circuit taken from the extremities of the generator, the experiments showing at that moment that the difference of potential was at least 1,900 volts. M. Cornu was violently projected to the distance of some paces, but without falling. The two fingers which had touched the metal received two burns, not very serious, but rather deep. This injury was accompanied by stupefaction for some seconds. Such were the only results of this accident, but the general sensation may be conceived. Misfortune is not without its uses, and M. Cornu, on recovering after a few minutes, remarked that it was an interesting experiment. Currents of high tension were much dreaded; it had even been announced that their effects were like those of lightning, such alarming assertions being based upon accidents which had occurred with light machines. It was forgotten in this

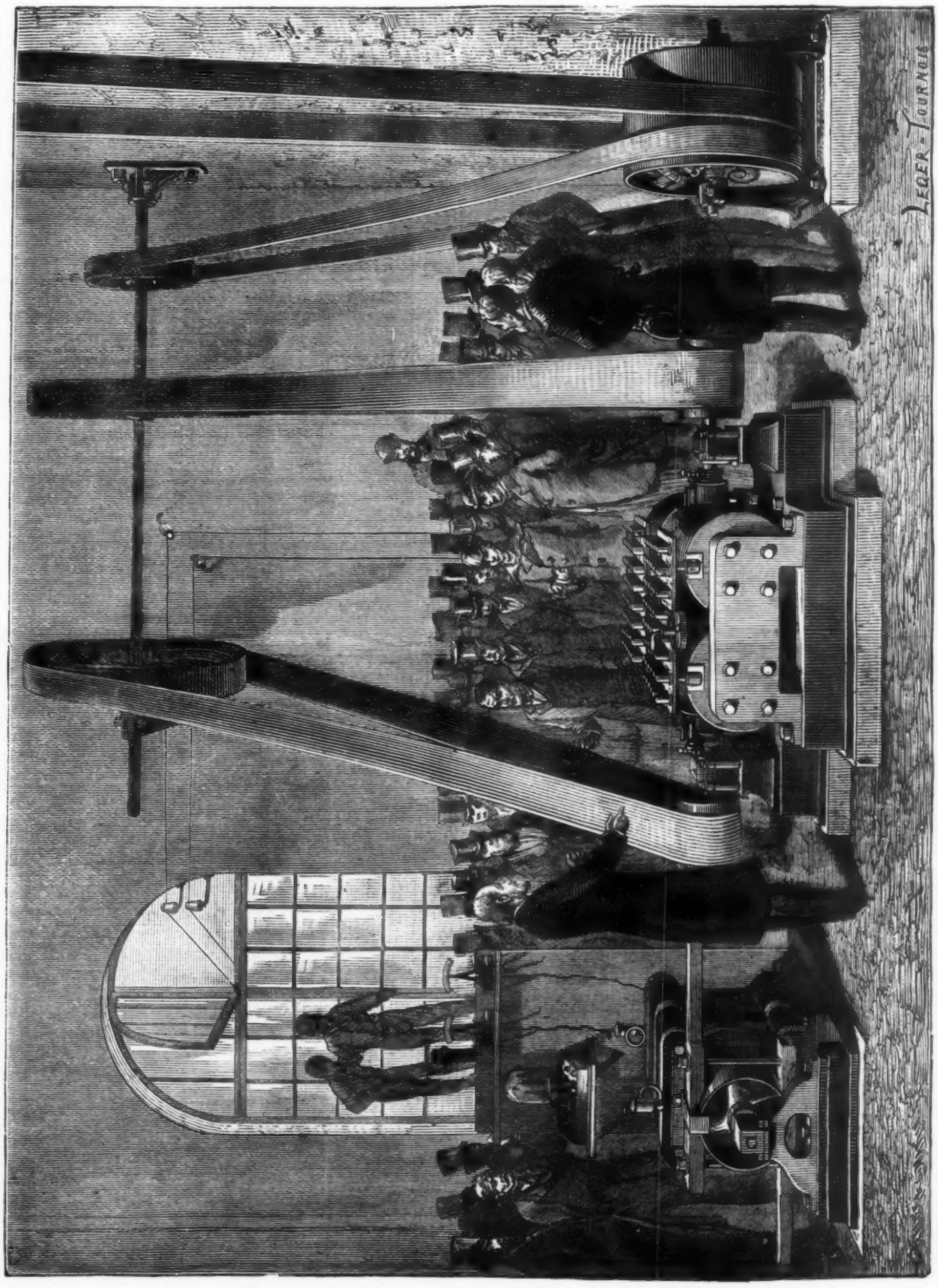

FIG. 9.—INSTALLATION IN THE WORK-ROOMS OF THE NORTHERN RAILWAY OF FRANCE.

comparison that the latter were machines with alternating currents, but the others continuous current machines. The difference of the physiological effects is very great, an alternating current having a tension of 600 volts is almost certainly fatal, whilst a continuous current of 1,900 volts, if not free from danger, does not kill.*

The report drawn up by the Commission of the Academy of Sciences concludes as follows:—"In fine, the results obtained by M. Marcel Deprez, conformable in every respect to the theoretical principles which ought to guide engineers, surpass by far all that had heretofore been accomplished, by the magnitude of the work transmitted, in comparison with the resistance of the transmission conductor, and are, moreover, remarkable for the mechanical yield obtained.

"The Commission is not prepared to judge the economical value and the industrial future of the results obtained; but, from the thorough examination which they have made of the apparatus and the principles brought into play, they do not hesitate to proclaim the importance of the facts which they have been enabled to verify.

"In consequence, they propose to the Academy of Sciences to congratulate M. Marcel Deprez on the important progress which he has effected in the solution of the interesting problem of the electric transmission of energy, and encourage him to pursue his labours, continuing, as hitherto, to place the resources of an in-

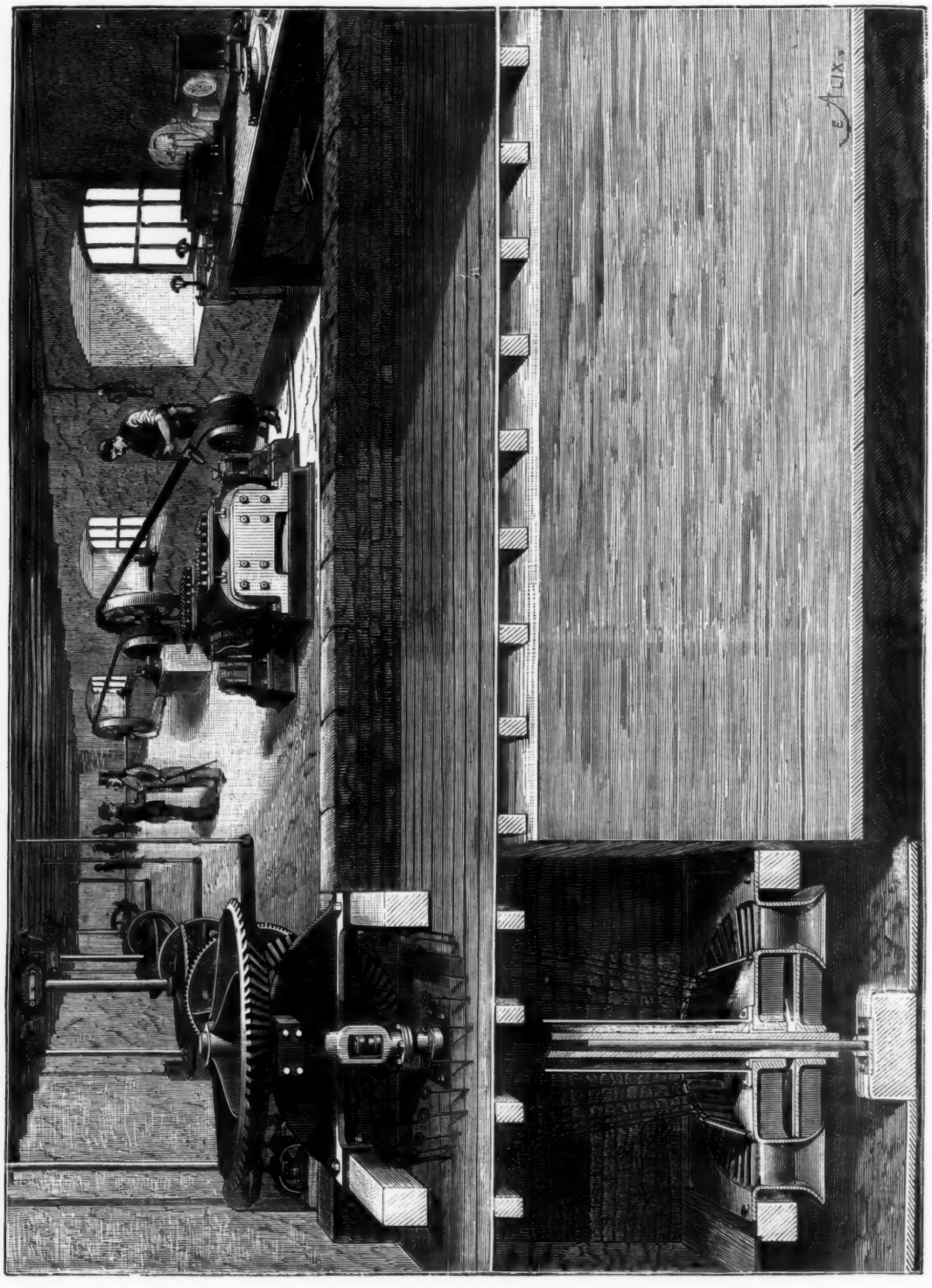

FIG. 11.—INSTALLATION AT VIZILLE.

*[M. Geraldy is evidently misinformed on this point.—EDS. ELEC. REV.]

genious mind at the service of the best established principles of electrical science."

Number of the Experiment.	NUMBER OF REVOLUTIONS per minute.		MECHANICAL WORK.		NET YIELD.
	Generator.	Recipient.	Supplied at the Generator.	Collected at the Recipient.	Transmission deducted.
1	378	104	3·838	0·578	0·176
2	370	88	3·854	0·489	0·147
5	850	602	9·771	3·344	0·435
6	923	709	10·556	3·939	0·477
7	850	643	9·514	3·572	0·482
8	1,024	799	12·267	4·439	0·456

The advance made, as compared with the Munich experiments, was certainly considerable; the force transmitted was increased from one-fourth to four and a-half horse-power, the yield had risen from 30 to 48 per cent.; the distance, though less, was still, in effect, considerable, and the two stations were, in fact, in the same electrical relations * as if at the distance of 8·5 kilometres from each other.

In reality, as we know, they were not separated; the Commission had made special electric measurements, showing that the influence of this arrangement was nil, and that the machines acted quite as if they had been at a distance; nevertheless, this gave scope for criticism. It must be added that, in consequence of the circumstances already mentioned, the experiments had to be made rapidly; the high velocities could only be maintained during the time necessary for taking account. Scientifically the results were obtained; industrially speaking they might require confirmation.

M. Marcel Deprez, however, had no intention of resuming these trials with the machines which he had used. Such as they were, the experiments made on the North of France Railway, joined to the numerous laboratory experiments, were sufficient for determining the proper construction of machines for transmitting great powers to long distances; he went to work, therefore, to prepare practical models.

(To be continued.)

EARLY HISTORY OF THE TELEGRAPH.†

THE history of the invention and introduction of the electric telegraph by Professor Morse is one of inexhaustible interest, and every incident relating to it is worthy of preservation. The incidents described below will be found of special interest. The article is from the pen of Judge Neilson Poe, and was the last paper written by him. He prepared it during his recent illness, the letter embodied in it from Mr. Latrobe being of course obtained at the time of its date. It is as follows:

"On the 5th of April, 1843, when the monthly meeting of the directors of Baltimore and Ohio Railroad Company was about to adjourn, the president, the Hon. Louis McLane, rose with a paper in his hand, which he said he had almost overlooked, and which the secretary would read. It proved to be an application from Professor Morse for the privilege of laying the wires of his electric telegraph along the line of the railroad between Baltimore and Washington. and was accompanied by a communication from B. H. Latrobe, Esq., chief engineer, recommending the project as worthy of encouragement.

"On the motion of John Spear Nicholas, seconded by the Hon. John P. Kennedy, the following resolution was then considered:

"Resolved," That the president be authorised to afford Mr. Morse such facilities as may be requisite to give his invention a proper trial upon the Washington Road, provided in his opinion, and in that of the engineer, it can be done without injury to the road and without embarrassment to the operations of the company, and provided Mr. Morse will concede to the company the use of the telegraph upon the road without expense, and reserving to the company the right of discontinuing the use if, *upon experiment*, it should prove *in any manner injurious*.'

"'Whatever,' said Mr. McLane, 'may be our individual opinions as to the feasibility of Mr. Morse's invention, it seems to me that it is our duty to concede to him the privilege he asks, and to lend him all the aid in our power, especially as the resolution carefully protects the company against all present or future injury to its works, and secures us the right of requiring its removal at any time.'

[In view of the fact that no railroad can now be run safely without the aid of the telegraph, the cautious care with which the right to remove it if it should become a nuisance was reserved, strikes one at this day as nearly ludicrous.]

"A short pause ensued, and the assent of the company was about to be assumed, when one of the older directors, famed for the vigilance with which he watched even the most trivial measure, begged to be heard.

"He admitted that the rights and interests of the work were all carefully guarded by the terms of the resolution, and that the company was not called upon to lay out any of its means for the promotion of the scheme. But notwithstanding all this, he did not feel, as a conscientious man, that he could, without further examination, give his vote for the resolution. He knew that this idea of Mr. Morse, however plausible it might appear to theorists and dreamers, and so-called men of science, was regarded by all practical people as destined, like many other similar projects, to certain failure, and must consequently result in loss and possibly ruin to Mr. Morse. For one, he felt conscientiously scrupulous in giving a vote which would aid or tempt a visionary enthusiast to ruin himself.

"Fortunately the views of this cautious, practical man did not prevail. A few words from the mover of the resolution, Mr. Nicholas, who still lives to behold the wonders he helped to create, and from Mr. Kennedy, without whose aid the appropriation would not have passed the House of Representatives, relieved the other directors from all fear of contributing to Mr. Morse's ruin, and the resolution was adopted. Of the president and 30 directors who took part in this transaction, only three, Samuel W. Smith, John Spear Nicholas, and the writer, survive. Under it Morse at once entered upon that test of his invention whose fruits are now enjoyed by the people of all the continents.

"It was not, however, until the spring of 1844, that he had his line and its appointments in such a condition as to allow the transmission of messages between the two cities, and it was in May of that year that the incident occurred which has chiefly led to the writing of this paper.

. . . . . .

MR. LATROBE'S RECOLLECTIONS.

"My Dear Mr. Poe,—Agreeably to my promise, this morning I put on paper my recollection of the introduction of the magnetic telegraph between Baltimore and Washington. I was counsel of the Baltimore and Ohio Railroad Company at the time, and calling on Mr. Louis McLane, the president, on some professional matter, was asked in the course of conversation whether I knew anything about an electric telegraph which the inventor, who had obtained an appropriation from Congress, wanted to lay down on the Washington branch of the road. He said he expected Mr. Morse, the inventor, to call on him, when he would introduce me to him, and would be glad if I took an opportunity to go over the subject with him, and afterwards let him, Mr. McLane, know what I thought about it. While we were yet speaking, Mr. Morse made his appearance, and when Mr. McLane introduced me, he referred to the fact that as I had been educated at West Point, I might the more readily understand the scientific bearings of Mr. Morse's invention. The president's office being no place for prolonged conversation, it was agreed that Mr. Morse should take tea at my dwelling, when we would go over the whole subject. We met accordingly, and it

* [Our readers will doubtless remember our criticisms on the method adopted of joining up these machines, a method manifestly unfair and misleading.—EDS. ELEC. REV.].

† *Kansas City Review.*

was late in the night before we parted. Mr. Morse went over the history of his invention from the beginning with an interest and enthusiasm that had survived the wearying toil of an application to Congress, and with the aid of diagrams drawn on the instant, made me master of the matter, and wrote for me the telegraphic alphabet which is still in use all over the world. Not a small part of what Mr. Morse said on this occasion had reference to the future of his invention, its influence upon communities and individuals, and I remember regarding as the wild speculations of an active imagination what he prophesied in this connection, and which I have lived to see even more than realised. Nor was his conversation confined to his invention. A distinguished artist, an educated gentleman, an observant traveller, it was delightful to hear him talk, and at this late day I recall few more pleasant evenings than the only one I passed in his company.

"Of course, my first visit the next morning was to Mr. McLane to make my report. By this time I had become almost as enthusiastic as Mr. Morse himself, and repeated what had passed between us. I soon saw that Mr. McLane was becoming as eager for the construction of the line to Washington as Mr. Morse could desire. He entered warmly into the spirit of the thing, and laughed heartily, if not incredulously, when I told him that although he had been Minister to England, Secretary of State, and Secretary of the Treasury, his name would be forgotten, while that of Morse would never cease to be remembered with gratitude and praise. We then considered the question as to the right of the company to permit the line to be laid in the bed of the road—the plan of construction at that time being to bury in a trench some eight or ten inches deep a half-inch leaden tube containing the wrapped wire that was to form the electric circuit. About this there was, in my opinion, no doubt, and it was not long after that that the work of construction commenced. I met Mr. Morse from time to time while he lived, and often recurred to the evening's discussion at my house in Baltimore.

"JOHN H. B. LATROBE."

"*March 3rd*, 1881."

ELECTRICAL LAUNCHES.

ON Wednesday, the 2nd of April, a paper was read before the Institution of Naval Architects by Mr. A. F. Yarrow, who gave a description of the electrical launch built last year. He said:—"The object of the present paper is to briefly describe an electric launch built last year jointly by the Electric Storage Company, Messrs. Siemens Bros., and ourselves. After numerous trials had taken place with it on the Thames, it was forwarded to Vienna, where it was shown at work on the Danube during the Electrical Exhibition.

I do not propose to trace what has previously been done in this direction, that having been already fully dealt with by others, more particularly of late by my friend Mr. Reckenzaun, in communications to the British Association* and to the Society of Arts;* to these papers I would refer those gentlemen who are interested in this subject, treated more particularly from an electrical point of view.

The losses incurred in the process of charging storage cells by which the launch was driven, and giving off electricity are estimated differently by various authorities. An average of these estimates gives approximately the following:—

	Per Cent.	Residue per Cent.
Starting with the engine which drives the dynamo, converting mechanical energy into electric energy, there is a loss of	15	85
Loss in passing the electricity into the accumulators	10	76½
Loss due to the reverse action, namely, converting stored electricity into mechanical energy	25	57½
Leaving an estimated residue of 57½ per cent.	—	—

* Re-published in the ELECTRICAL REVIEW.

From our own experience I am satisfied that the power required to charge the cells at our works, compared with the ultimate power given off to drive the launch under ordinary working conditions, shows that a return of from 45 to 50 per cent. may certainly be relied on.

The motor made by Messrs. Siemens Bros. they state to be capable of working up to 8 to 9 H.P. tested on the brake, but in the launch it probably did not exceed 7 H.P.

	Tons.	Cwts.
The weight of the hull was	2	0
The weight of the storage cells	2	0½
The weight of the dynamo, shafting, stern tube, and propeller	0	10
Making a total displacement of	4	10½

The dimensions were 40 ft. in length by 6 ft. beam.

Owing to the very low position of the accumulators, a narrower beam in proportion to length is admissible than in a steam-launch assuming an equal stability in both cases, and any reduced resistance due to the finer lines may fairly go down to the credit of the electrical system.

On a continuous run it was found that as the accumulators became weakened the speed gradually fell off. During the first three hours this reduction amounted to about half a knot per hour. To meet this difficulty when a continuous run was required at a uniform speed a certain number of cells, say fifty or sixty, for example, were connected up, the current from these only driving the motor at first, and as it fell off other cells were coupled up and brought into the circuit, so that the additional fully-charged cells made up for the deficiency of those partially exhausted. In this manner the boat could be kept running for five to six hours.

If, however, the best result was required for a short time only all the cells were connected up, and the full power used.

The best result obtained at Long Reach, with six persons on board, and a displacement of about five tons, having seventy-one cells in circuit, was 6·9 knots, *i.e.*, eight statute miles, the revolutions of the motor being 674 per minute. Each cell, when fully charged, weighing ½ cwt., is stated to be equivalent to one net horse-power for an hour developed on the shaft, but I believe, in actual practice, a considerable reduction from this estimate must be made. No doubt, had the motor been designed with the view to make a less number of revolutions, greater efficiency would have been obtained from the propeller, which was 24 in. diam. by 13 in. pitch.

Comparing this electrical launch with a steam launch provided with an ordinary high-pressure engine, giving the steam launch an increased beam, in order to secure the same stability, making engine, boiler, water in boiler, and coals sufficient for a six hours' run, equal in weight to the accumulator and motor, the mean speed of the steam launch would have been from 1½ to 2 miles an hour faster than the electrical launch. Had it been for use in salt water, necessitating a supply of fresh water as well as fuel to be carried for the six hours, the above advantages in favour of steam would be much reduced.

Touching the time occupied in charging the accumulators, this depends upon the amount of current generated in the first instance. Assuming the least waste or loss of energy is desired, the time for the charging process should occupy about 25 per cent. longer than the giving-off process, *i.e.*, if the boat is to run for six hours, the charging should be estimated to occupy seven and a half hours. It can be done faster, but with a greater loss of power.

The leakage of electricity when standing depends to a great extent upon the perfection of the insulation; this loss has been estimated by different authorities at from 2 per cent. to 10 per cent. per day. We ourselves took no steps to test this, but I can say that if the accumulators were charged on a certain day, the boat would be available for use any time during the following week.

It will be seen that as it is ready for use at any moment, consequently in this respect it should be compared with a steam launch having steam always up. In the one case, however, a man must be in constant attendance, while in the other this is unnecessary.

The difficulties that we met with while the launch was in our hands were not so great as we expected, and were in a great measure due to want of experience on our part; this was especially the case as regards insulation, sufficient care not having been taken in the first instance. The motor gave some trouble, probably due to passing excessive currents through it with a view to obtain the best possible speed, and after a run of half an hour or so on two occasions, the machine became over-heated, the insulating covering of the wires being damaged. These difficulties, on better acquaintance with the subject, would doubtless vanish.

As to the cost of working, I will abstain from any attempt at giving figures, which, at the present stage of development of the subject, would be unreliable.

Touching the durability of the accumulators, we have no experience ourselves, but I believe, when in the hands of those who thoroughly understand them, the wear and tear is by no means excessive or prohibitory.

They may be spoilt in a few minutes by neglect or inexperience. The same, however, can be said of a team-boiler.

As to the durability of the motor, the wear and tear of this would, I believe, be small, although the strains are considerable; there is no change from a reciprocating to a rotary motion necessary, and every part of the machine is capable of being balanced with great accuracy.

As to the direction in which to look for improvements, not being an electrician, I am unable to suggest, but what is evident at a glance is that both dynamos, as well as accumulators, find a sale mostly for electric light purposes, in which case they are stationary, and weight is no object. I believe in the direction of a reduction of weight something at least might be secured to improve this system as applicable to propulsion. At present the limit of power which a motor is capable of developing is partly determined by the heat produced by the current in passing through the wires, and the risk of destruction of the insulating material surrounding these wires, which is usually cotton or silk. It has been suggested to substitute for these asbestos, or some non-conductor capable of withstanding a high temperature. If this is practicable, a more powerful current could be employed, and a greater power developed from a given weight of machine.

Comparing the electrical system with steam, the advantages in favour of the former may be stated briefly as follows:

(1) Entire absence of noise.
(2) Great cleanliness.
(3) The whole of the boat is available for passenger accommodation, the midship, or best part of it, not being occupied by machinery.
(4) When once charged, it is ready for use at a moment's notice.

The points against it are:—

(1) Difficulty and delay in frequent charging.
(2) Greater first cost.
(3) Greater cost of working in those cases where an engine has specially to be laid down for the purpose of charging.

Probably the first cost of the accumulators may be ultimately materially reduced, there being a very large difference between their present price and their cost of production.

Under those circumstances, where the above objections exist to a minimum, and the advantages to a maximum extent, the electrical system, even at its present stage of development, seems to me to be quite available; for example, when a natural source of power exists, such as a fall of water, a dynamo may be easily driven, and at a nominal cost, to charge the cells. If wished, this could be done during the night. and the boat would be available for use during the day. Under such conditions, the electrical system would, I believe, have a balance of advantages in its favour.

It is reasonable to suppose that electrical boats may be found useful for various purposes, such as pleasure yachts; and fitted up as torpedo boats for night attack, being perfectly noiseless, and without funnel or fire to betray their existence they would seem to be eminently suitable.

To what extent the electrical system as regards its application to propulsion may in the future develop, it is clearly impossible for anyone to foretell, but if the launch which I have had the honour to describe is to be looked upon as a link in the chain of advance, I would desire to add that the credit belongs to the electrical engineers with whom I had the pleasure to be associated."

A discussion followed the reading of Mr. Yarrow's paper, in which Admiral Selwyn, Mr. Liggins, Mr. White, Mr. Henry Morgan, and Mr. Reckenzaun took part.

AN EXPLANATION OF HALL'S PHENOMENON.

In the Electrical Review for April 5th, 1884, we published a paper by Mr. Shelford Bidwell on Hall's phenomenon. We notice a reply to that article in our contemporary *Science*, from the pen of Mr. Hall himself. He writes:—"Mr Bidwell's table is certainly very suggestive, but his 'explanation of the Hall phenomenon' cannot stand.

"He makes this phenomenon to be an incidental result of the manner in which the metal strip is attached to the plate of glass. It is, he says, like a beam rigidly fastened at both ends, and weighted in the middle. Without discussing the closeness of this analogy, one can see, that if we fasten the strip by its middle, and leave it free at both ends, the conditions upon which Mr. Bidwell supposes the phenomenon to depend are quite changed.

"After reading Mr. Bidwell's paper, I took a strip of soft steel, about one-tenth of a millimetre thick, and made the usual connections, but, instead of fastening the strip to glass with cement, so arranged it that it could at will be clamped across its middle or across the ends to a sheet of hard rubber. The end clamps were about three centimetres apart, and the width of the magnetic poles between which the strip was placed was considerably greater than three centimetres. Now, when the strip was clamped across its middle and left free at the ends, and was made to conduct a current of electricity across the magnetic field, it was like a beam supported at the middle, and with a load distributed from end to end; but when the strip was clamped at its ends and left free in the middle, it was like a beam supported at both ends, and with a load distributed from end to end. Experiment shows that the effect is positive, as I have always found it in iron and steel, whether the strip be clamped in the middle or at the ends.

"There is one other consideration to be urged. Mr. Bidwell would, I suppose, account for the fact that the observed effect is proportional to the magnetic force by saying that the strain would be proportional to this force. But how will he explain the fact that the effect is nearly or quite proportional to the current, as was shown in my first paper upon the subject? Let us see what his theory leads to. Doubling the current, the magnetic force remaining unchanged, would double the strain. But a doubled strain, with a doubled current, would make the heating and cooling from the Peltier effect four times as great as before. This would deflect the equipotential lines four times as much as before; and, as these lines are only half as far apart as before, the transverse current would be eight times as great as before the direct current was doubled. The transverse effect, then, would be proportional, not to the current, but to the cube of the current."

RESISTANCE OF THE ELECTRIC LIGHT CARBONS EMPLOYED IN LIGHTHOUSES.*

NOTE BY M. F. LUCAS, PRESENTED BY M. CORNU.

THE carbons or cylindrical pencils used in France for the production of the voltaic arc in lighthouses are manufactured by M. Carré, the carbons intended for producing the ordinary light called the single light, are 0·016 m. in diameter, and those for exceptional occasions, when the atmosphere is very foggy, called double lights, 0·024 m.

The resistance cold (at the normal temperature of about 15° C.) of the Carré pencil is, on an average, and according to a great number of measurements taken with a Wheatstone bridge, 70 ohms per square millimetre of section and per metre of length, but the deviations above and below this average are rather high among the carbons, sometimes attaining 25 and 30 per cent.

We know that the resistance of these carbons diminishes as the temperature increases; this resistance should consequently diminish as a more and more intense current passes through the pencil, and especially with the alternating currents produced by the magneto-electric machines which are employed for lighthouse service. It will be interesting to ascertain how the resistance of the carbon varies with the intensity of the current. I have made for this purpose some experiments which gave the following results.

The pencil tested was 0·016 m. in diameter and 0·40 m. in length, between two copper sockets which surrounded its two extremities; its resistance at a temperature of 15° C. was

$$\gamma = 0{\cdot}152 \text{ ohm.} \tag{1.}$$

This pencil was introduced into the external circuit of a De Meritens machine being connected by a known length of thick copper cables, of which the resistance was measured beforehand. In order to obtain currents of various intensities, the speed of rotation of the armature was made variable, as well as the mode of connecting up the bobbins and the length of the copper cables.

In each experiment the intensity, I, of the current was measured by means of the electro-dynamometer; the number of revolutions per minute, n, of the armature were indicated by a counter. In order to calculate the total resistance, R, of the external circuit, we had recourse to tho formula

$$\text{R} = \frac{a + \alpha n}{\text{I}} - (r + b + \beta n) \tag{2.}$$

as I pointed out in a note inserted in *Comptes Rendus* of the 17th March last. The parameters, a, α, r, b, and β, were numerically known for each mode of connection of the bobbins of the magneto-electric machine.

By subtracting from R the known resistance of the copper cables, we obtained the resistance γ of the pencil corresponding to the current of intensity I. The results obtained led me to the empirical formula

$$\gamma = \gamma_0 \left(1 - \frac{\text{I}}{25 \text{ amp.} + 1{\cdot}2\,\text{I}}\right); \tag{3.}$$

the intensity, I, having varied during the experiments from 50 to 142 ampères, the coefficient γ_0 diminished from $\frac{1}{3}$ to $\frac{1}{4}$. Taking I for the abscissa and γ for the ordinate, we obtain one branch of a hyperbola having a horizontal asymptote.

For each intensity, I, the pencil has a temperature, T. By letting fall upon the surface of the pencil pieces of various alloys or simple bodies of known fusibility, and melting from 94° C. (Darcet metal) to about 900° (bronze), I was able to determine two tolerably approximate values between which the temperature, T, would range. I found thus 400° for 50 ampères, 450° for 60 ampères, 550° for 75 ampères, 700° (dull red) for 100 ampères, and 850° (cherry red) for 140 ampères. These results lead to the empirical formula

$$\text{T} - 15° = \frac{\text{I}}{0{\cdot}112 \text{ amp.} + 0{\cdot}0004\,\text{I}} \tag{4.}$$

Eliminating T from (3) and (4), we find

$$\gamma = \gamma_0 \frac{1 + 0{\cdot}0005\,(\text{T} - 15)}{1 + 0{\cdot}0005\,(\text{T} - 15)} \tag{5.}$$

which applies for values of T included between 400° C. and 900° C.

Let us designate by

$$\theta = \text{T} - 15° \tag{6.}$$

the excess of the temperature of the pencil over the ambient air. The number, K, of calories disengaged per second in the preceding experiments were equal to

$$\text{K} = \frac{\gamma\,\text{I}^2}{4154} = \frac{0{\cdot}0477\,\theta^2 + 0{\cdot}000024\,\theta^3}{104000 + 434\,\theta - 0{\cdot}397\,\theta^2 + 0{\cdot}000083\,\theta^3} \tag{7.}$$

The cooling surface, for a cylinder 0·016 m. in diameter and 0·400 m. in length, being approximately 20000 mmq., it would suffice to divide K by 20000, to obtain the fraction of a calorie disengaged for each value of θ per square millimeter of surface of the pencil. This formula (7.) applies, like the preceding, to values of θ included between 400° and 900° C.

* *Comptes Rendus.*

NOTES.

Electric Lighting.—At a recent meeting of the Chesterfield Town Council, the Watch Committee reported that the contract for lighting the borough by the Hammond Electric Light and Power Supply Company, Limited, expiring on the 1st of next month, the committee had asked that company, and also the Chesterfield Water Works and Gaslight Company. to tender for the lighting for a period of one or more years by electric light and by gas respectively. The Hammond Company wrote, saying they did not intend to tender, as they had very pressing demands for engines, &c., for private lighting at a place where much higher figures were offered than those current in Chesterfield. An interview took place between the directors of the gas company and the committee, and, after considerable discussion, the former offered terms which the committee recommended the council to accept, as they were much below the former charges for lighting the borough by gas. It was resolved to adopt the committee's recommendation, Alderman Wood remarking that it was no disgrace either to the town or to electricity that, after a trial of the latter, they decided to return to the use of gas; they availed themselves of the use of the electric light at a time when it was a choice between oil, electricity, or darkness, and it had had the object of ensuring a much better arrangement with the gas company than they would otherwise have obtained. A resolution was passed acknowledging the efficient way in which the town had been lighted by the Hammond Company, and the readiness with which the company adopted the suggestions of the Watch Committee from time to time. A movement is on foot for the presentation of a testimonial to Mr. Ellison, the local manager of the Hammond Company, in recognition of his courtesy during the recent inquiries.

Experiments with a system of electric lighting, introduced by Messrs. Paget Higgs, Limited, Edinburgh, were, on Monday night, exhibited in the furniture saloon of Messrs. John Mitchell & Son, Princes' Street, whose premises are in future to be lighted by means of electricity. Planté-Higgs accumulators and Dr. Higgs's patent compound wound self-regulating dynamo machine are employed. The results shown were thought to be highly satisfactory, the light produced being perfectly steady, and so pure that the most deli-

cate shades of colour could be distinguished and matched as readily as in sun light. The strength of the current could also be so regulated as to enable all the lights but one to be turned out without any alteration to the lamp which remained lighted.

A large number of leading firms in Boston, says the *Electrical World*, have petitioned the City Council of Boston to increase the appropriation for electric lighting from $94,000 to $125,000, and to increase to that extent the number of lights. They speak most highly of the electric light, and say that Boston was never adequately lighted until its introduction.

The Syracuse, N.Y., Common Council, at its meeting on March 25, says the same journal, gave the Brush-Swan Electric Light Company the right of way in the streets under the provisions of the resolution drafted by the City attorney. Mr. Avery said that the company would put from $50,000 to $100,000 in a plant in that city, and that after organisation a local company would be formed and stock sold to Syracuse investors.

Washington, says the *Electrical World*, now presents a most brilliant spectacle at night. An appropriation was made recently by Congress to be used by the local Brush-Swan Electric Light Company, of which Mr. A. A. Hayes is the president, in lighting the Capitol, the Smithsonian Institution, and the Washington Monument. Twelve lights have been put on the "tholus" at the top of the dome of the Capitol, the height from the ground being 285 feet. As the Capitol itself stands at a considerable elevation, the effect produced is very striking, and the light can be seen many miles off. One light has also been placed in the rotunda of the Capitol. The ten lights on the Washington Monument are over 400 feet in the air, and are higher than those on any other building in the country, perhaps in the world. Six more lights are placed on a mast on the highest tower of the Smithsonian building. These three centres of illumination are within the radius of a mile, and thus diffuse a soft and pleasing light in the upper air. Around each group of lights the gas lamps are extinguished. The circuit on which the lights are placed embraces nearly five miles of wire, starting from the station on Second Street, between B and C. One dynamo is used at present. It is proposed, when the monument at last stands complete, to place a light at the top.

Major S. B. Eaton writes to a New York contemporary :—"I have just returned from a visit to the small country towns where our (Edison) isolated system is in operation. They are thirteen in number. Two syndicates are forming to extend this work. The gas companies have cut under us, of course. But we keep our price up at the rate of $2·25 per thousand for gas, and earn dividends after the first six months. Our lamp factories have already shipped this year 80,000 lamps to Europe. Companies for lighting Paris and Berlin have just been formed. What are we doing for New York? We are adding to the power at the down-town station. Our business there will average $10,000 a month. A central station will be built this summer near Madison Square for house illumination. We have also contracted to light the new Eden Musée, Park and Tilford's new store, and the Gorham silver-ware building in this city. Ninety per cent. of our stock is held by five people, who do no trade in it."

According to a New York journal, it is said by those who should know, that the new Thomson-Houston 60-light machine, full standard lights, with only a single commutator, is the "boss" machine. There is no difficulty in believing anything good about this system.

It is stated that a Boston (America) gas manufacturer asserts that the demand for gas has increased in that city since the introduction of electric lights.

The Minister of Public Works has resolved to apply the electric light to the railway trains in Italy. Various experiments are being made before adopting a definite system.

The Bell Telephone Company.—The annual meeting of the Bell Telephone Company was held in Boston, on the 25th ult., and was very largely attended. Mr. William H. Forbes presided. A resolution appointing a committee to report upon the various controversies in which the Bell Company is at present engaged was tabled. The report of the directors stated that the growth of business for the past year had been healthy, and in some directions very active. The demand for new telephones fell off during the winter months, but the net output for the year was 57,299 against 60,337 for the previous year. The number of miles of wire in use had increased during the year from 13,653 to 29,359. Since the last report 165 new exchanges have been built, 13,417 miles of new wire added in the exchanges, and 25,798 new subscribers connected. The treasurer's statement for the year ending February 29, 1884, showed that the gross earnings for the year were $2,295,594·07, and the net earnings $1,475,431·37, as against $972,044·28, the year before, an increase of $503,000. Adding balance of income from previous year and miscellaneous credit items, there was a total of $1,734,804·78, out of which dividends had been paid of $1,051,479, $334,441·61 carried to surplus account, leaving a balance to the income account of $348,844·17. In Canada the Bell Telephone Company's affairs are in good condition, and 6 per cent. dividends are paid upon its capital of $1,000,000. The tendency toward consolidation of telephone companies noticed in the last report had continued, and was for the most part in the interest of economical and convenient handling of the business. The directors and their associates had the strongest motives for wishing to get wires underground as far and as soon as it could be done without destroying the efficiency of the service. But although short trunk lines worked fairly well beneath the surface, as shown in Boston and elsewhere, in the present state of the art it was impracticable to put the bulk of the wires underground without interfering seriously with facilities upon which the public are now getting to depend. Conversation over long lines (those reaching the suburbs even) was difficult and often impossible to those who were connected through the underground cables. The number of connections in the United States was estimated as at the rate of 215,280,000 per annum or 4·85 per subscriber per diem. The average rate for distances inside 35 miles was 25 cents. for which at least 100 words each way could be had if desired, with all the advantages of immediate response. The average rate to the public at telephone toll stations for short circuits was 15 cents. The average price of telegraph messages in the United States was 38 cents, and for distances inside of 35 miles about 20 cents, and the rate for short circuits about 15 cents. Especial attention was being given to long line service, and a new line between Boston and New York, was almost ready for trial.

The Rogers Telephone.—Yesterday morning, says the Washington *Republican* of March 21, a competitive test between the Bell telephone and the Rogers telephone was made in Philadelphia. The Disston Bros., well known millionaires, requested Mr. Rogers to make this test over a seven-mile wire, between their two factories, and pronounced the Washington invention far superior to the Bell telephone. Among the gentlemen present were Dr. Beckwith, who started the "Baxter" or "overland telephone," clearing $70,000. He was greatly delighted with the competitive test, and immediately secured an interest in the new telephone.

The Drawbaugh Evidence.—The People's Telephone Company, representing the Drawbaugh claims, has, announces the *Electrical World*, concluded its testimony at Harrisburg, Pa. The company has been examining witnesses for several months in that city in rebuttal of testimony given in the interest of the American Bell Telephone Company, and maintains that it has greatly strengthened its case. The next meeting will

be held in Philadelphia, when the Bell Telephone Company will produce witnesses to question its claim to priority in inventions. It is probable that the long pending case will be submitted to the New York courts next summer.

Oriental Telephone Company, Limited.—A dividend at the rate of 5 per cent. per annum for the year ending December 31st, 1883, has been declared.

Cable Repairs.—The manager of the Direct Spanish Telegraph Company, Limited, announces that direct cable communication with Spain, *via* Bilbao, is now again fully restored, and that a duplicate cable is in course of construction, and will shortly be laid between England and Bilbao.

Telegraphic and Telephonic Communication in Edinburgh.—At a recent meeting of the Edinburgh Chamber of Commerce, Mr. Harris said there was a growing desire that they should have greater facilities for telegraphic and telephonic communication, in the interests of trade and commerce, than they had ever yet had. He briefly traced the development of the use of telegraphs, stating that in 1851 the rate for a message of 20 words from London was 10s.; in 1855, and up to 1862, it was 4s.; in 1865 it was 2s.; and it was owing to the Chamber moving in the matter, under their present worthy Lord Provost, that the rate was reduced in 1870 to 1s. He referred to the anomalous position of the Government in relation to telephones. They held that they had the monopoly, under the Telegraph Act, of the whole telephone system of the country. Owing to that he said they in this country stood in the background, as compared with other countries, with regard to the extension of telephones. The great difficulty which stood in the way seemed to be the enormous amount of money that had been spent on the extension of the telegraph system. The Government had spent £10,131,000, but that was a bugbear that need not exist, because if they were to charge one penny extra on the present number of telegraphic messages, the Government would recoup themselves of that sum in 40 years. He stated that the number of telegraphic messages in 1870 was 6½ millions, and in 1880 26½ millions. The revenue in 1870 was little over half a million, and in 1880 a million and a-half. He combated the argument that the encouragement of the telephonic system would be antagonistic to telegraphs, by stating that since the introduction of telephones in America, telegraphic communication had increased 33 per cent. As an advantage in favour of the telephone, he pointed out that it could be used without skilled labour, and that the whole cost was in putting up the wire. He referred to the offer made by the Postmaster-General with regard to transmitting telephonic messages over the telegraph wires where necessary, as the beginning of what might lead to successful negotiations. Mr. F. Faithfull Begg quoted from a letter written by Dr. Siemens to the *Times* in 1881, in which he stated that the German Government had laid 8,000 miles of underground insulated wire, and that since they had been laid no expenditure for maintenance had been incurred, and, judging from the perfect condition of the cables, it was not likely that any repairs would be required for many years; and said he was convinced that this system would be not only the most perfect, but would prove the cheapest in the end. With reference to the offer made by the Postmaster-General to transmit telegraphic messages communicated at the Post Office by telephone for five guineas extra per annum, he said the Government wished to charge five guineas for receiving that which was taken from the public for nothing. It was agreed to remit the matter to the directors.

Electrical Experiments.—Rowland's famous experiment demonstrating the magnetic action of electric convection has been called in question by Dr. E. Lecher, of Vienna. In Rowland's original experiment the electrified rotating disc was horizontal, and the magnetic needle, protected from electrostatic influences by being enclosed in a metallic case, was held over the disc at a point near the circumference. Dr. Lecher, in attempting to repeat the experiment, placed the rotating disc in a vertical plane, its axis being horizontal; the magnet needle was placed parallel to the plane of the disc and in the axis of its rotation, in fact relatively as the coil and needle of a Gaugain galvanometer. Discs of brass and of *papier-maché* covered with graphite were used, and charged from a Holtz machine to potentials of about 5,000 volts, as measured on an absolute electrometer. The velocity of rotation was about 200 revolutions per second. The astaticised needle was protected within a metal case, and was observed in the usual way by a mirror. No deflection was observed either when the disc was still or when it rotated. Dr. Lecher intends to repeat Rowland's experiment with the original horizontal disposition of the disc. Dr. Lecher has also made another experiment of great interest. A ray of light was divided, as in many experiments on interference, into two parts, which, after passing through two parallel glass troughs, were caused to reunite, giving the usual interference-bands. The troughs contained strong solutions of nitrate of silver. By means of electrodes of silver an electric current of 6 ampères strength was carried in opposite directions along the troughs, so that in one trough the current flowed *with* the light, and in the other against it. But in no case was any displacement of the fringes observed. Dr. Lecher concludes that the vel city of light is not influenced by a current flowing through the medium. Dr. Lecher has made a third and still more interesting experiment, attended, however, like the preceding, with a negative result. This was an attempt to prove whether Faraday's famous experiment of rotating the plane of polarisation by an electric current could be inverted. He has attempted to generate currents by rotating the plane of polarisation of light. The arrangement was as follows:—A ray of plane-polarised light was sent through the interior of two powerful helices of wire situated at some distance from one another. Through the first of these a powerful alternate current was sent, which impressed upon the ray a rapid oscillation of its plane of polarisation. The second helix was connected to a sensitive receiving telephone in the hope that sounds might therein be heard, as would be the case if the rapid rotations in the plane of polarisation of the ray were capable of setting up currents in the surrounding wire. Absolutely nothing was, however, heard.—*Nature.*

Patent Decision Affecting Electric Lighting.—"E. B." sends the subjoined to the *Electrical World* (New York):—"A cablegram was received a few days ago at the offices of the Bernstein Company in Boston, stating to the effect that the petition of the German Edison Company, asking to make the Bernstein light patent subordinate to and dependent upon the Edison filament patent (No. 12,174), has been rejected by the German Patent Office, and the patent was granted to Mr. Bernstein as covering a different system, and, therefore, one independent of the other patents. This decision, although entirely in accordance with the merits of the case, brings to the foreground the eventual possibility of two monopolies, viz., the one using the filament, and the other the Bernstein tube; and although the filament lamps have enjoyed up to this time a better financial backing, the greater efficiency of the Bernstein lamp, as recently reported upon by the Vienna Commission, has already aroused some noted European capitalists to develop the light of the future; and we understand that the policy of the Bernstein company, which thus far laboured under the prejudices aroused against them by the defunct Gramme 'ring,' will in future be aggressive and in keeping with the high opinion its system earned in Europe."

Underground Wires.—The Committee of the Massachusetts Legislature that has been considering the

question of ærial electric light wires has, we learn, come to the conclusion that it is not expedient to compel the companies to put their wires underground.

Senator Daly's bill requiring telegraph, telephone, and electric light wires to be put underground by June 1, 1885, in cities of 500,000 inhabitants or over, says an exchange, came up for final passage in the New York Senate on the 3rd inst., and was passed.

The Efficiency of Secondary Generators.—M. Hospitalier, the editor-in-chief of our French contemporary, *L'Electricien*, has an article in the last issue of that journal, in which he severely criticises Dr. Hopkinson's report on the the Gaulard-Gibbs secondary generators. After commenting upon the figures given, M. Hospitalier calculates that the industrial return of the apparatus is but 63·4 per cent. He thereupon says :—"In order to appreciate the importance of this result, we must not forget that in Edison's system, for instance, the loss by the conductors does not exceed 10 per cent., and that in high potential systems, as with the Brush machines, the conductors are calculated to limit the loss to an equivalent figure. If the system of distribution by derivation could be worked with a loss of 37 per cent. in canalisation, it would not be difficult to effect distribution at as great a distance as with the generators of Messrs. Gauland and Gibbs. The independence of the lights would also be ensured, and we should have the immense advantage of distributing a current which, by its character, was susceptible of more numerous and more varied applications than alternating currents. We are of opinion that we ought, on principle, to dispense with all intermediaries which do not render services equivalent to the sacrifices which they impose, and the secondary generators of Messrs. Gaulard and Gibbs seem to us to be in this category."

A Proposed American Electrical Institute.—The *Electrical World* publishes the call or prospectus of a proposed national electrical institution, and states that the support that has been accorded to the proposition by leading men is nothing short of remarkable. The list given of the names of those who were within immediate reach of the projectors, and to whom the call was therefore first submitted, is a representative one, and would of itself stamp the society as worthy of support and as sure of success. The day fixed for the preliminary meeting is May 12th, and if measures are then actively pushed forward the society will be an accomplished fact and in prosperous existence before the opening of the International Exhibition at Philadelphia, and the arrival of the hundreds of European *savants* who promise to visit it.

Lecture on "The Electric Light in our Homes."—On Wednesday evening, Mr. Robert Hammond explained the use of the electric light for domestic illumination, in St. James's Hall, and described in a popular manner the characteristics and mode of production of light with the incandescent lamp. On the platform of the great hall, where the lecture was given to a large audience, was a room fitted up with furniture, curtains, pictures, ornaments, flowers, &c., brilliantly lighted with different in andescent lamps, and he showed how the electric light produced in this manner fulfilled the several conditions required in a system of house illumination. It was healthful, and did not, like gas, use up the oxygen of a room or give off fumes noxious to health or injurious to pictures, frames, or decorations. Produced with a low tension current, and with conducting rods and wires of sufficient diameter, there was no danger to life or of fire, its safety in the latter respect being shown by the readiness of insurance companies to issue policies for houses thus lighted on the same terms as for those in which gas was used ; while, as a matter of fact, if the installation was properly made it was far safer than any other kind of illuminant. It was a pleasant light, it was easy of control, and could be lowered without being turned out, and, lastly, it was not necessarily costly. No experiments on a sufficiently large scale had yet been made in England to enable one to say exactly for how little the light could be supplied for domestic purposes, but he believed they would see it, when prepared on as large a scale as gas, distributed at an equivalent of 3s. per 1,000 feet to the consumer.

A Wonderful Dynamo.—We read that a Mr. Bain, of the Bain Electric Company, Chicago, has invented a dynamo, a small type of which produces eight arc lights of the usual power—whatever this may mean—for an expenditure of less than one and one-third horse-power. Other well known systems, it is said, cannot produce such a result with less than 10-horse power. It would be highly interesting to know how Mr. Bain calculates his horse-power expenditure. It is just possible that the figure given above should be multiplied by ten.

The Resistance of Electrolytes.—In a paper which appears in the *Transactions of the Royal Society of Canada*, Prof. Macgregor describes an arrangement devised by him for measuring on Wheatstone's bridge the resistances of electrolytes. He employs alternating currents produced by a rotating commutator inserted in the circuit of two Daniell's cells ; and in order to use with this arrangement an ordinary mirror-galvanometer, he recommutates the currents in the galvanometer circuit by means of a second commutator rotating on the same axle as the first. Professor Macgregor does not appear to be aware that the late Sir Charles Wheatstone devised, many years since, an apparatus similar to the above. We ourselves, in some experiments made for Sir Charles for the purpose of obtaining the resistance of electrolytes, used this instrument at least 10 years ago. Instead of rotating, however, both the battery and galvanometer commutators simply vibrated backwards and forwards very rapidly between metallic contacts, each one being actuated at the same time by a handle common to both.

Copyright in a Telegraph Code.—In the Chancery Division of the High Court of Justice on Wednesday, the 9th inst., Mr. Justice Kay gave judgment in the case of "Ager *v.* The Peninsular and Oriental Steam Navigation Company, Limited," which was an action brought by Mr. Ager, the publisher of an expensive book, containing a collection of words selected from eight languages for use in the transmission of telegraphic messages, and which might be used by anybody for making a telegraphic code. The defendants, who had invented such a code, had availed themselves of this very largely, and had printed in a publication of their own the bulk of the plaintiff's words, attaching to them meanings of their own. They contended that, as their book was marked "private" and was given away, not sold, to their own agents and correspondents only, there had been no infringement of the copyright. His lordship, however, held that the case was made out and granted an injunction to prevent the defendants from printing or distributing any further copies of their book.

Personal.—Messrs. Woodhouse and Rawson have secured the services of Mr. W. L. Madgin (late district manager in Ulster of the National Telephone Company) as manager of their Electrical Supply Department in London.

Electrical Units.—The meeting of the International Congress for the Determination of Electrical Units, which was held at Paris last year, will recommence its sittings in May next.

Society of Arts.—Amongst the announcements for May of meetings in connection with this society are the following :—May 14, "Telpherage," by Professor Fleeming Jenkin, F.R.S. ; May 21, "Telegraph Tariffs,"

by Lieut.-Col. Webber, R.E.; May 28, "Primary Batteries for Electric Lighting," by J. Probert.

The Criterion Theatre.—Perhaps the chief among the many improvements introduced by Messrs. Spiers and Pond at the above theatre is the illumination of the entire house by the electric light. The work was entrusted to the Edison Company about the middle of last year, and was carried on by them until the amalgamation with the Swan Company. The joint company has completed what is perhaps the most perfect example of theatre-lighting in London. The total number of lights in use is over 600, divided approximately as follows;—

Overhead battens	204
Side and vertical lights	92
Ground rows	20
Float-foot lights	48
Auditorium	141
Passages and corridors, &c.	85
Dressing rooms, &c.	22
	612

The control of the lights is even more effective and absolute than the ordinary gas system. In the auditorium and stage there are about 510 lights, and these are divided into 10 separate circuits, each of which can be raised or lowered by means of German silver wire resistances introduced into the circuits, each of which is subdivided into 15 gradations, and all can be controlled singly, or as one common circuit, and either circuit can be extinguished without perceptibly affecting the remaining lights. The lamps used are all of the Edison pattern, ranging from 10 to 50 candle-power. The general effect produced by the light is as good as can possibly be desired, and we need hardly dilate on the pleasant change in the temperature and freshness of the air of the house, so often noticed by visitors to the Savoy Theatre, which is, we believe, the only other theatre in London completely lighted by the electric light. The temperature of the air in the house never rose above 60 degrees. The steam power is obtained from boilers put in for other purposes, such as heating, &c. The engines are two in number, of the Armington and Sims high speed type, each capable of doing the whole of the work at their normal speed of about 240 revolutions per minute. Each engine is connected, by means of leather belting and friction clutches, to a counter-shaft, on which are placed four smaller friction clutches, which are in turn connected by belts to four Edison L machines, the normal output of each machine being 150 lamps. But should occasion arise, it could for a limited time be increased to about 200, so that if one machine failed it could be instantly disconnected, and the remaining 3 would then drive 600, practically all the lights absolutely necessary. We are told, however, that Messrs. Spiers and Pond are intending to add two larger dynamos of the same type, so as to have more spare machine power, and to enable them to light up their new grill room, which would be an inestimable boon to all West end wayfarers. The work has been most carefully carried out by Mr. T. O. Belshaw, assistant engineer of the Edison-Swan Company. Since starting the permanent running of the light on the 15th inst., there has been no hitch of any description, and the success of the undertaking appears to be beyond all doubt.

The Empire Theatre.—The ballet at this newly-opened theatre in Leicester Square is, we hear, rendered additionally attractive by the use of some Trouvé electric jewels. These have been supplied by Mr. Armand Levy, of Goswell Road, and are connected with small batteries, the current lasting for about half an hour.

Companies' Shares.—On Thursday, at the sale of the Stock and Share Auction and Advance Company, £10 fully-paid shares of the Spanish National Submarine Telegraph Company realised £7; £5 shares of the Electro Amalgamator Company, £4; and £5 shares of the Electric News Telegraph Company, 25s.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Anglo-American Brush Electric Light Corporation, Limited.—An Order of the Chancery Division of the High Court of Justice, dated 22nd ult., and filed with the documents of this company on the 8th inst., sanctions the reduction of the capital of the company, as authorised by the special resolution passed at the meeting held on the 6th of February and confirmed on the 27th of February. The Order also directs the addition of the words "and reduced" to the title of the company be dispensed with.

CITY NOTES, REPORTS, MEETINGS, &c.

The Hammond Electric Light and Power Supply Company, Limited.

THE shareholders of this company held their third ordinary general meeting on Thursday, at the works, Appold Street, Finsbury, Sir Charles Young, Bart., presiding. The directors' report, which we published fully last week, and the accounts for the past year were submitted to the meeting.

Mr. Latham, the Secretary, having read the notice convening the meeting,

The Chairman moved the adoption of the report and accounts, and whilst doing so reviewed at some length the history and progress of the company, and of electric lighting generally. The net result of the doings of the last two years was that their business had been extensively advertised, and the public, hard to move in regard to domestic improvements, were beginning to regard electric lighting with serious interest, and as something more permanent and genuinely profitable than a mere speculation in shares. What they had suffered from more than anything else was the variety of systems; those with whom they reasonably expected to do business in a large and profitable way declared their intention of awaiting the results of the experiments being carried out by the various owners of patents, mainly at their own expense, and then availing themselves of whichever was proved to be the best system. This company had had to work under very adverse circumstances, but had laid a solid foundation for the future, and the directors saw no need for continuing any work which did not show a profit. Their object should be to succeed in establishing central stations, from which house to house lighting might be carried on in the same way as gas was now supplied, for in that manner alone could a good and paying business be secured. Neither primary nor secondary batteries would solve the problem of house-to-house lighting; a direct supply from a central station, and payment according to the amount consumed, was what the public wanted, and he made bold to say that the first company that achieved that end would be the first to give a splendid pecuniary recompense to its proprietors. The shareholders would be asked to pass resolutions which would give the company power to raise further share capital, and make a new departure, unweighted with a paper liability. They were now carrying out contracts at Brighton, Birmingham, Nottingham, Norwich, Middlesborough, Manchester, Cambridge, Eastbourne, and other centres, and they had a provisional order for the Hampstead district, to which they attached considerable importance. They would shortly be in a position to commence work in that district, a piece of land having been selected for the station, and the first large dynamos proposed to be used being in hand, and a satisfactory amount of local support had been promised, which it was likely would be numerously and substantially increased when the residents saw that they meant business. He ventured to say that no electric company had made such solid progress as theirs had, and if they had not achieved any great pecuniary results, what, after all, was two years in the history of such a work as theirs?

Mr. Hammond, in seconding the adoption of the report and accounts, dealt chiefly, and at considerable length, with the latter. He said, unfortunately, however strong their faith in the ultimate future of this industry, they were now face to face with a very serious loss, and it was necessary for them to consider most thoroughly whether that loss was one that would recur in such volume that the company would have to be wound up, or whether there were elements that would prove it to be transitory. He proceeded to explain each item in the balance sheet, and asserted that it had been decided to set down every liability that could possibly come upon the company, and to state every asset at its true value. In the course of an exhaustive analysis of the finances, he pointed out that the bulk of the charges were such as could not possibly recur, and stated that no contracts would be undertaken which would not result in a clear profit to the company. Referring to house-to-house lighting, he said he was more and more convinced that, with sufficient money, the establishment of stations might be worked very well, and it was to enable them to raise that money that they were asked to carry the resolutions to be submitted to the extraordinary general meeting. The college was working very satisfactorily, and proved to be a paying experiment. With regard to exhibitions, they had determined to avoid them as far as possible. In connection with the approaching Health Exhibition, the authorities had agreed to their conditions, and the

company would not sustain the loss of a single farthing. After remarking that he was convinced of the advisability of an amalgamation in some form of the Anglo-American Brush Corporation, the Swan and Edison United Company, and the Hammond Company, Mr. Hammond concluded by seconding the adoption of the report and accounts, which were then passed.

The meeting having been constituted an extraordinary general meeting, the following resolutions were submitted from the chair and carried:—

"That the nominal capital of the company, which now consists of the sum of £330,000, divided into 66,000 shares of £5 each, be increased to the sum of £525,000, and that this amount be divided into 350,000 shares of the nominal value of £1 10s. each."

"That 50,123 shares of the nominal value of £1 10s. each, forming part of the said capital of £525,000, be issued as fully paid-up, and that the same be applied in manner following, that is to say:—(*a.*) 40,133 of the said £1 10s. shares ratably to the present holders of the 40,133 ordinary £5 shares in this company. (*b.*) 7,990 of the said £1 10s. shares to the holders of the 15,980 deferred £5 shares in this company, and 2,000 of the said £1 10s. shares to the holder of the founder's shares in this company."

"That the directors be empowered to enter into such agreements or contracts as may be necessary for the carrying out of all or any of these special resolutions, and to issue and allot the balance of the authorised nominal capital of the company from time to time, on such terms and conditions as they in their discretion may think fit."

"That an indenture bearing date the 19th day of March, 1884, and made between the Hammond Electric Light and Power Supply Company, Limited, of the one part, and Robert Hammond of the other part be and the same is hereby ratified and confirmed."

The last resolution had reference to an agreement whereby Mr. Hammond consented to accept a yearly remuneration of £1,000 in consideration of his services as managing director, and to forego the two-fifths of all profits over 10 per cent. to which he was entitled under the original agreement. This met with some opposition, and Mr. Anson moved an amendment that Mr. Hammond should be offered 12½ per cent. of the net profits instead of a fixed remuneration, but only half a dozen hands were held up in its favour, and the resolution was carried.

The auditors, Messrs. Theobald Bros. and Miall, were re-elected, and the meeting terminated.

Faure Electric Accumulator Company, Limited.

THE general meeting called by the directors of this company was held at the Cannon Street Hotel on Wednesday. Shortly after the hour for which the meeting was called had passed,

Mr. Harcourt Turner announced that since the meeting of the shareholders last week the two remaining directors had resigned, and that therefore they had better proceed at once to determine what they should do.

The following letter from M. Philippart was distributed to the shareholders:—

"TO THE SHAREHOLDERS OF THE FAURE ELECTRIC ACCUMULATOR COMPANY, LIMITED.—My bankruptcy has brought about disastrous consequences to our common interest. It has indeed carried in its train and rendered inevitable the bankruptcy of the companies: La Société la Force et la Lumière, French Electrical Power Storage Company, Limited, and French Metropolitan General Electric Company, Limited.

"Deprived of my co-operation, my colleagues cannot, under these circumstances, do otherwise than place their resignation in your hands.

"As for myself, although I am vanquished, I continue to remain here on the breach, for I cannot desert the interests which have been confided to me, and which are mingled with mine. Although alone, I am still able to protect them.

"If my work and my help can be of any avail to you in Paris and in France I can, however, do nothing in England beyond giving you my best advice upon what I deem there remains to be done by you in our common interest.

"It must not be forgotten that the origin of our ruin dates from this time just two years since, when your directors refused to prosecute the English Electrical Power Storage Company, who had pirated our patents. The origin of all the evil arises therefrom, and to-day those who had pirated our patents having become everywhere the masters, and benefitting by events more and more unfortunate, now pretend not only to hold us well and duly dispossessed of our English patents, but even to retake gratuitously the French patents without making restitution for the considerable sums which we have paid them.

"Under these circumstances there is, in my opinion, only one thing to be done: It is to put at the head of your company those notable men who were its founders. Upon them is it incumbent to reassume the management of your interests, and it is their duty to agree to do so.

"Our company has no debts, and it has still a considerable amount to call up on a part of its shares. Herein are sufficient resources for claiming our English patents. That is what your directors ought to do.

"On my part here in Paris and in France I shall contest with our common adversary, the French patents, and I have no doubt of success, relying upon our right and upon French justice.

"Paris, the 10th day of April, 1884.

"S. PHILIPPART, ex-Director and Chairman."

Mr. Harcourt Turner was voted to the chair, and stated that the secretary, Mr. Canning, had been in communication with the directors as to their intention respecting the meeting they had called, and had received letters from them in which they desired that their resignations might be placed before the meeting, as the recent occurrences, the bankruptcy of M. Philippart, the resignation of M. Cadiot, and the illness of another director, made it impossible for them to continue in the position of directors. Under those circumstances there were now no directors left to carry on the business of the company, and he (the chairman) thought the best thing to do would be to confirm the appointment of the committee selected last week, and let them at once proceed to investigate the affairs of the company.

A Shareholder asked whether the exchange between the original company and the present one was carried out in a proper and legal manner, and whether the original directors remained in office until the transfer took place, as they promised they would do.

Mr. Campbell, solicitor of the company, replied that, as far as he was concerned, the exchange was effected completely, and

Mr. Canning, the secretary, said he could only speak as to the mechanical part of the work, and he knew that in every case of transfer, certificates were accepted for one fully-paid £10 share for two shares of £2 each.

Sir Arthur Otway said that when the shareholders of the original Faure Company—which, he maintained, was as good a concern as was ever started—contrary to his repeated advice, and after he had stated that in the event of its being adopted he and his colleagues would resign, unanimously decided to accept M. Philippart's offer, he said that, although he was fully acquitted of all duties, there was one he would still discharge—he would not allow any gentleman to incur further liabilities if he could prevent it. He told M. Philippart he would not leave, nor would his colleagues, until every shareholder had been offered the opportunity to free himself of every possible liability. Two trustees were appointed, Sir Charles Clifford and Mr. Campbell, and the great bulk of the shareholders did accept the new arrangement, freeing themselves of liability. Now, he thought, they ought to make an effort for those who had had greater faith than they in the new company, and he was perfectly willing to bear his share of the expense that had fallen upon them. What he would warn them against was this: he thought it would be unwise to consider the concern as altogether destroyed. He did not see why the shareholders of the original company, although they may have judged ill, should give up all hopes of the possibility of getting hold of the property in France. The solicitor of the company was not one to let the property escape, if they would give him power to act, and he would advise, first of all, that they should proceed to investigate the affairs of the concern, and then, if nothing occurred to render it unnecessary, to send Mr. Campbell to Paris to pursue investigations there; he possessed an intimate knowledge of the French law and had a thorough acquaintance with the French language; and when he came back and reported to them they would know much better where they were.

After further desultory discussion, Sir Arthur Otway moved the confirmation of the appointment of Sir Charles Clifford, Messrs. E. Ponsonby, W. D'Oyley, Harvey Rankin, Harcourt Turner, Solomon, Grenfell and Duncan as a committee of investigation, which was seconded and carried, the meeting shortly afterwards dispersing.

The Eastern Extension Australasia and China Telegraph Company, Limited.

THE following is the report of the directors for the six months ended 31st December, 1883, to be presented at the twenty-first ordinary general meeting of the company, to be held on Wednesday next:—

The gross receipts, inclusive of Government subsidies, have amounted during the half-year to £231,056 1s. 4d., against £209,131 12s. 5d. for the corresponding period of 1882, showing an increase of £21,924 8s. 11d.

The working and other expenses, including an exceptionally heavy item (£28,094 14s. 3d.) for cost of repairs and renewals of cables and expenses of ships, absorb £69,862 0s. 2d., against £54,782 13s. 4d. for the corresponding half-year of 1882, leaving a balance of £161,194 1s. 2d. From this is deducted £1,878 5s. 2d. for income tax, and £41,595 for interest on debentures and contributions to sinking funds, leaving £117,720 16s. as the net profit for the half-year, which, with the balance of £32,356 2s. 1d. brought forward from the previous half-year, makes a total balance of £150,076 18s. 1d. to be dealt with.

One quarterly interim dividend of 1¼ per cent. amounting to £31,250 has been paid during the half-year, and it is now proposed to distribute another of like amount, together with a bonus of 3s. per share, payable on the 24th instant, making with the interim dividends and bonus paid for the first half-year, a total distribution of 7 per cent. for the year 1883. The balance of £50,076 18s. 1d. has been carried to the reserve fund, which now stands at £462,821 7s. 1d.

The directors have the pleasure to report that the negociations with the French Government, to which reference was made at the last general meeting, resulted in a convention being signed on the 21st November last, by which that Government undertook to pay to the company a subsidy of £10,600 per annum for 20 years in consideration of the company providing and maintaining a cable, 800 miles in length, between Cape St. James (Cochin-China) Thuan-An (Hué) and Tonquin.

A contract was subsequently entered into with the Telegraph Construction and Maintenance Company for carrying out the work, which was successfully completed, and the line opened for traffic on the 17th February last.

A second convention was made with the French Government, authorising the company to lay a cable between Tonquin and Hong-Kong. The cable is now being laid by one of the Company's ships, and with the exception of a short length of heavy type, will be provided from the company's stock of cable at Singapore.

By means of these arrangements the company will obtain a reliable alternative communication between Cape St. James and Hong-Kong.

The directors have also to report that a contract has been negociated with the Portuguese Government for connecting Macao with the company's system at Hong-Kong, in consideration of which the company are to receive a subsidy of £500 per annum for 10 years. This cable, about 50 miles in length, will also be provided from the company's stock at Singapore.

A government land line has lately been completed connecting the Indian Government lines at Tavoy with Cochin-China through Siam, which at present affects a portion of the traffic between Cochin-China and India and Europe. Arrangements are in course of negociation to meet this competition by an equitable adjustment of the tariffs.

The company's line between Hong-Kong and Kowloon has been connected with the Imperial Chinese Telegraph system from Canton, bringing that important treaty port into direct communication with the company's system.

In consequence of the destruction of the Netherlands Indian Government's cable across the Sunda Straits by the terrible earthquake that occurred last year, the Government applied to the company to assist them in re-establishing telegraphic communication. This assistance was readily accorded, and an arrangement was entered into between the company and the government under which a new cable was recently laid by the Telegraph Construction and Maintenance Company between Java and Sumatra.

The Madras-Penang cable was again interrupted near the Nicobar Islands from the 15th to the 24th November. The weather being favourable no difficulty was experienced in effecting repairs.

The repairs to the Java-Australian cables, referred to in the last report, were successfully completed by the s.s. *Agnes* on the 11th December. The work was a long and difficult one, on account of the bad weather that prevailed for several months.

A length of about 400 knots of brass-ribboned cable has also been recently inserted in the original Java-Australian line from Port Darwin to the edge of the Sahul Bank, where the teredo has been found to be very troublesome, and both cables are now in perfect working order.

Other important renewals and improvements are also in course of progress which will make the company's system more perfect, the cost of which will be brought into the current year's accounts.

The land line belonging to the South Australian Government, between Port Darwin and Adelaide, has, as usual, been well maintained.

The Electrical Power Storage Company, Limited.

THE following report of the directors is to be presented to the shareholders at the annual general meeting, to be held on Wednesday next:—The capital of the company, which last year stood at £599,000, is changed in two respects:—First, 35,100 shares have been surrendered as part of the arrangement with the French Electrical Power Storage Company; and second—the sum of £1,000 appearing in the last balance sheet as calls unpaid has been received. The total issued share capital now stands therefore at £529,800, in 264,900 fully paid-up shares of £2 each.

The belief expressed last year by the directors in the security and comprehensiveness of the patents possessed by the company is confirmed by the fact that it is virtually without a rival as an electrical accumulator manufacturer. The official report of the tests made under the authority of the Imperial Commission of the Vienna Exhibition, which has been looked forward to with much interest, is not yet published, but it is gratifying to be able to state that the highest claims made as to efficiency of the accumulators are known to have been fully established.

The impediments thrown in the way of the progress of electric lighting have acted most prejudicially to the interests involved, and have necessarily affected this company in a marked degree. The extensive demands which were reasonably to be anticipated, consequent on the expected rapid development of electric lighting, have not been realised on the scale for which the company made preparations at their Millwall Works, but the premises and plant have been maintained in a thorough state of efficiency and repair, and are suitable for carrying out and executing with all necessary rapidity the large business which must come with the inevitable progress of electric lighting. The amount of stock and materials has been again estimated at the actual present value, viz., £18,417 5s. 7d., the heavy fall in the market value of lead alone causing a large depreciation. The loss shown for the year, beyond this depreciation in the value of stock, may justly be considered as in the main incidental to the introduction and development of a new business of a peculiar and novel character, and as of a kind not likely to recur. These and other causes have necessitated the proposal for reduction of capital hereafter recommended by the directors.

Certain installations have at various times been undertaken by the company for demonstration and experiment, and the directors regret to find they have occasioned a greater expenditure than was contemplated; on the other hand, the practical knowledge and experience gained are very valuable. Great attention has been paid to the production of improved forms of accumulators. The experiments made with the Cone form tend to show that for certain purposes it possesses advantages, and the new clamp cell designed by Mr. J. S. Sellon promises very satisfactory results.

The competition amongst electrical companies has been so keen that some of them have knowingly accepted contracts entailing considerable loss, for the sake of advertisement. When, therefore, the periods arrived for renewal of contracts for work engaged in by this company, when a reasonable profit might have been obtained, this unwholesome competition interfered, and the directors being unwilling to undertake any permanent work which would not yield a fair profit, determined not to renew any contracts under which this was not assured, considering the advantage and value of accumulators for electric light installations to have been fully demonstrated. The largest of these, viz., at the Grand Hotel, has been most successful in this respect, and the proprietors, Messrs. Gordon & Co., have written to the company, stating "that the light given and general arrangements were entirely to their satisfaction;" and that "bearing in mind the motive power at the disposal of the company, it would have been impossible successfully to have carried on the electric lighting at the Grand Hotel without accumulators." From the nature of such contracts it is of course impossible to realise at their termination the whole cost of the installation, and a considerable sacrifice is therefore involved by this abandonment.

The directors refer with much satisfaction to the installation made by the company at the Bank of England, and also to the successful employment of accumulators in London, at the Gaiety and Prince's Theatres, Eberle's Army and Navy Hotel, Messrs. Antony Gibbs & Son's offices, Lord Randolph Churchill's residence; in Liverpool, at the Grand Hotel and Eberle's Restaurant; and in Parkeston, at the Great Eastern Railway Company's station, besides other important installations. A profitable business is also arising in the temporary supply of electric light for ball rooms and private mansions, a number of such installations having been recently carried out.

Reference was made in the last report to the amount received by sales of patents to the Indian and Oriental Electrical Storage and Works Company. In consequence of representations made to them the directors have concurred in the reduction of the share capital of that company, and the nominal amount of shares held therein will be therefore reduced from £50,000 to £35,000. During 1883, £5,000 in cash was received from that company, and since then a further sum of £5,000, being the balance of the cash payable. With regard to the French business the directors are at this moment compelled to observe a great degree of reticence, as in consequence of complications which have arisen the company is now acting in the matter under legal advice both in England and France.

During 1883, Mr. J. Irving Courtenay has been in America in charge of the company's interests. The proceedings and negociations there have necessitated a heavy outlay, from which, however, the directors are advised the shareholders may confidently expect a good return.

The directors much regret, however, to have to announce to the shareholders that the sanguine hopes entertained at the commencement of the year have not been fulfilled. As the shareholders are aware, the business of the company is twofold; first, the industrial or manufacturing branch, and secondly, the dealing with foreign patents. The depression in electric lighting has been so unexpected and prolonged that this company, being of necessity mainly dependent upon others for its business, has suffered with more than proportionate severity in the former, while as regards the latter, the high estimated value of electrical patents entertained at one time has not been maintained, and for the present there is a great depreciation in the value of such property. It is impossible, therefore, to say what realisable value attaches to the company's foreign patents now, although the patents themselves are still as perfect as ever.

After most careful consideration, your directors have come to the conclusion, that with the present large issued capital of the company (£529,800) it cannot be anticipated that the industrial business alone will yield a distributable profit, but they believe that a successful manufacturing business can be profitably carried on, and show good returns on a smaller capital. They therefore recommend that the issued capital of the company shall be reduced by £397,350, that sum representing what they consider to be at the present time the amount of unavailable assets and of loss which should be written off, thus reducing the issued amount to £132,450. The adoption of this course will not in their opinion injure the ultimate value of the patents, and will enable the shareholders more speedily to divide any profits made in manufacturing. Special resolutions prepared by counsel to effect this in the most convenient manner will be submitted to the meeting.

The Indo-European Telegraph Company, Limited.

THE directors' report for 1883 is as follows:—The company's revenue from all sources for 1883 amounted to £100,065 12s. 7d. The expenses were: On commercial and general account, £26,526 16s. 1d.; on maintenance account, £28,227 15s. 10d., including £336 7s. 1d. paid to the Russian Government; total,

£54,754 11s. 11d. Deducting the above expenses, taking credit for £449 17s. 6d. balance brought over from 1882, and debiting income-tax, there remains the sum of £44,903 1s. 6d. From this amount, £10,625 paid for interim dividend, £5,000 placed to reserve, and £5,843 16s. 2d. paid on account of the Persian debt, have to be deducted, leaving a balance of £23,434 5s. 4d. available.

The directors propose the declaration of a dividend for the last six months of 17s. 6d. per share, making with the interim dividend already paid, 6 per cent. for the year, and a bonus of 10s. per share, both free of income tax, making in all 8 per cent, for the year. The balance of £59 5s. 4d. will be carried to the credit of 1884.

The amount charged on account of the Persian debt under the notice referred to in the report for the year 1882, completes the payment of the total amount for which the company incurred the liability, and the items standing to suspense account will be gradually recouped by annual deductions from the royalties payable by the company to the Persian Government, commencing with 1884.

The company has opened a branch office at 10 and 11, Mincing Lane, and has leased from the Post Office a special wire to place the branch in direct communication with the chief office. The maintenance by the company of its own lines continues to work satisfactorily.

The conclusions arrived at by the Cable Conference, for the protection of submarine cables, held at Paris, have, it is understood, been adopted by the Governments participating, and have been embodied in an International treaty.

The shareholders are aware of the lamented death of Sir William Siemens, who, with his brothers, Dr. Werner and Mr. Karl Siemens, originated, and in face of many difficulties carried out the company's line to successful completion.

The Brazilian Submarine Telegraph Company, Limited.

THE following report of the directors for the half year ended 31st December, 1883, is to be submitted to the 21st ordinary general meeting on Wednesday next. The revenue for this period amounted to £50,443 0s. 9d., and the working expenses to £12,227 3s. 2d. After providing £406 5s. for income tax, there remains a balance of £37,809 12s. 7d.; to this is added £19,434 4s. 8d., brought forward from 30th June last, making a total of £57,243 17s. 3d. First and second interim dividends amounting to £39,000, have been paid, and £18,000 transferred to the reserve fund, leaving the sum of £243 17s. 3d. to be carried to the next account.

The break in the St. Vincent-Pernambuco cable, referred to at the last meeting, was repaired on the 4th December, 1883, by the s.s. *Scotia*. The cable recovered was found to be in excellent condition.

A second interruption occurred in the same section on the 2nd March last, which was repaired on the 28th of that month.

The second section of the duplicate lines has been successfully laid between Madeira and St. Vincent, according to the terms of the contract with the Telegraph Construction and Maintenance Company. The expedition with the cable for the St. Vincent-Pernambuco section will sail about the end of June, and it is expected the duplication of this company's entire system will be completed by the middle of July next.

All the company's cables are now in good working order.

Reuter's Telegram Company, Limited.

THE report to be presented at the 20th ordinary general meeting of the shareholders, on Wednesday next, is as follows:—

The directors beg to report that the net profits for the year ending 31st December last, after payment of current charges, and deducting rebate on unexpired subscriptions, amount to £5,858 4s. 2d., including £92 18s. 8d. brought forward from the last account.

It will be in the recollection of the shareholders that owing to exceptional expenditure in 1882, the sum of £2,500 was transferred from the reserve fund to the profit and loss account of that year.

The directors deem it prudent, therefore, to appropriate a portion of the increased profit made in 1883 to strengthen the reserve. They accordingly have carried the sum of £1,950 11s. to that fund, making it £10,000.

The usual interim dividend of 2½ per cent. was paid in October last, and the directors now declare a further dividend of four shillings per share, equal to 2½ per cent., making a total distribution, free of income tax, of 5 per cent. for the year. This will absorb £3,703 6s. 8d., and after adding £1,950 11s. to the reserve fund, there will remain a balance of £204 6s. 6d. to be carried forward.

The dividend warrants will be payable on the 23th inst.

Great Northern Telegraph Company of Copenhagen.—After paying, for the year 1883, an interim dividend of £75,000, an extra dividend of £45,833 6s. 8d., adding £55,555 11s. 1d. to the reserve and renewal fund, making that fund £318,271 11s. 7d., and contributing £2,222 4s. 6d. to the pension fund, this company is enabled to carry forward a balance of £25,644 7s. 5d.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotatns, April 16.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	8	2¼ - 2½	2⅞
		Do. Do.	10	4¼ - 4½	4½
30,000	5	Australasian E. L., Power & Storage Co.	2½	..	
24,300	10	British Insulite Co., Ld., "A" Shares	5	..	
30,000	5	Brush Elec. Lt. & Power Co. (Scotland)	2½	..	
25,000	5	Gt. Western Electric Light & Power Co.	2½	⅛ - ¼	
24,980	5	Hammond Elec. Lt. & Power Sply. Co.	5	1 - 1¼	1⅛, 1
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2½	..	
250,000	1	Maxim-Weston Elec. Lt. & Power Co.	1	¼ - ½	
100,000	5	Metrop. Brush Electric Lt. & Power Co.	5	..	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	2½	..	
20,000	5	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.	5	1¼ - 1½	
		TELEGRAPHS.			
1,892,480*l.*	Stk.	Anglo-American, Limited	100	35½ - 36¼	35¾, 6½
2,553,760*l.*	Stk.	Do. Pref. { Def. receiving no div. until }	100	63½ - 64½	64
2,553,760*l.*	Stk.	Do. Def. { 6 p. c. paid to Pref. }	100	8¾ - 9	9
120,000	10	Brazilian Submarine, Limited	10	10 - 10¼	10⅛, ⅛
10,000	10	Cuba, Limited	10	9⅞ - 10⅛	
6,000	10	Do. 10 per cent. Preference	10	10¾ - 17½	
13,000	10	Direct Spanish, Limited	9	4 - 4¼	
6,000	10	Do. 10 per cent. Preference	10	14 - 15	
65,000	20	Direct United States Cable, Ld., 1877	20	10 - 10½	
100,000*l.*	100	Do. 6 per cent. Deb., repayable 1884	100	97 -100	
380,000	10	Eastern, Limited	10	10⅝ - 11⅛	11, ⅞, 11
70,000	10	Do. 6 per cent. Preference	10	13⅛ - 13⅝	13⅜, ¼
200,000*l.*	100	Do. 5 do. Debs., repayable Aug., 1887	100	101-104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	102-106	
250,000	10	Eastern Exten., Australasia & China, L.	10	11¼ - 11½	
320,000*l.*	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	107 - 110	
500,000*l.*	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	101 - 104	
140,000*l.*	100	Do. do. reg., repayable 1900.	100	102 - 105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 - 105	
550,000*l.*	{ 100 / 100	{ Eastern & South African, Ld., 5 p. c. / { Mort. Deb. Rg. redeemable 1 Jan. 1900 / Do. do. do. To Bearer	100	102 - 105	
20,030	10	German Union Telegraph & Trust, Ld.	10	9⅞ - 10¼	
250,000	10	Globe Telegraph & Trust, Ld.	10	6¼ - 6½	6⅜
250,000	10	Do. 6 per cent. Preference	10	12¾ - 12⅞	
150,000	10	Great Northern	10	15⅜ - 15½	
100,000*l.*	100	Do. 5 per cent. Debentures	100	101 -104	
200,000*l.*	100	Do. 5 per cent. Debentures	100	101 -104	
81,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	22¾ - 23¼	23¼
100,000	100	Do. 6 per cent. Debs., 1886	100	100 -105	
18,000	25	Indo-European, Limited	25	31 - 32	
100,000*l.*	1·6	Do. 6 per cent. Debentures	100	102 -104	100¾
40,000	10	London Platino-Brazilian, Limited	10	3¾ - 4	
12,000	10	Mediterranean Extension, Limited	10	1¼ - 1½	
3,200	10	Do. 8 per cent. Preference	10	2 - 4	
10,000	8	Reuter's, Limited	8	9 - 9¼	
338,223*l.*	Stk.	Submarine	100	185 -195	
75,000	1	Do. Scrip	1	1¾ - 2	
4,200	Cert.	Submarine Cables Trust	100	97 -100	98¼
37,350	12	Telegraph Construction and Mainten.	12	32¾ - 33¼	
150,000	100	Do. 6 per cent. Bonds, 1884	100	107 -109	
186,750	5	Do. 2nd Bonus Trust Cert.	2½	1¼ - 1½	
30,000	10	West Coast of America, Limited	10	6¼ - 6¾	
150,000*l.*	100	Do. 8 per cent. Debs.	100	108 -110	
45,791	15	Western and Brazilian, Limited	15	5¾ - 5⅞	5¾
24,119	7½	Do. Preferred	7½	4¾ - 4⅞	
24,119	7½	Do. Deferred	7½	¾ - 1⅛	
200,000*l.*	100	Do. 6 p. c.. Debs. "A" 1910	100	103 -106	105¼
250,000*l.*	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	98 -101	89½
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Rg.) Bds.	$1,000	122 -126	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	102 -106	
88,321	10	West India and Panama, Limited	10	¾ - 1	
34,563	10	Do. 6 per cent. 1st Preference	10	6¾ - 7	
4,669	10	Do. 6 do. 2nd do.	10	4¾ - 5	
		TELEPHONES.			
224,850	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	⅞ - ⅞	
225,000	1	Oriental Tele. Co., Nos. 80,001 to 300,000	¾	¾ - ¾	
100,000	5	United Telephone Co.	5	8 - 8¼	8¼
20,000	5	Do. New, issued 2 p.m.	2	..	

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending April 11th, were £2,610, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending March 31st, 1884, amounted to £6,080.

NEW PATENTS—1884.

6091. "Electric telephone transmitters." J. H. JOHNSON. (Communicated by J. A. Maloney.) Dated April 8.

6092. "Receiving telephones." J. H. JOHNSON. (Communicated by J. A. Maloney.) Dated April 8.

6096. "Telephone receivers, by which their efficiency for reproducing the voice, and all mechanical or musical sounds, is greatly increased." E. H. M. Andreoli. (Communicated by J. Boisselot.) Dated April 8.

6116. "Reducing metals by electrolysis." A. J. ROGERS, J. KOEBIG, H. MANN. Dated April 8. (*Complete.*)

6120. "Circular magnetic weaver's loom." E. WINCKLER. Dated April 8.

6128. "Electrical conductors or leads to be used in buildings, and for other purposes." M. SUGAR. Dated April 8.

6191. "Electrical indicators." W. H. BAUGHAN. Dated April 9.

6195. "Galvanic batteries." J. A. FLEMING. Dated April 10.

6228. "Secondary batteries or electrical accumulators." J. S. SELLON. Dated April 10.

6230. "Lamp combining electric light with gas light. E. Prédd. Dated April 10.

6232. "Electro-motors." T. CUTTRISS. (Communicated by C. Cuttriss.) Dated April 10.

6233. "Electric signalling apparatus for use on ships, in collieries, hotels, dwelling houses, and the like." E. P. TIMMINS. Dated April 10.

6234. "Pendulum indicator for electric bells." E. P. TIMMINS. Dated April 10.

6235. "Bases of electric bells." E. P. TIMMINS. Dated April 10.

6260. "Electrical distribution." W. H. SCOTT, E. A. PARIS. Dated April 12.

6261. "Dynamo-electric machines." W. H. SCOTT, E. A. PARIS. Dated April 12.

6312. "Photometers." W. H. PREECE, A. P. TROTTER. Dated April 12.

6372. "Sulphate of copper batteries." A. C. HENDERSON. (Communicated by J. B. G. Vauzelle & Sons.) Dated April 15.

6380. "Apparatus for the insulation and protection of electric wires laid either underground or in buildings, and to be employed for the transmission of powerful electric currents for electric lighting, and for other purposes; also bases for dynamos, bases for resistance boxes and switches, and for clips." T. PREECE, P. LOFTUS, J. R. WOODCOCK. Dated April 15.

6391. "Means for electro therapeutic treatment, or so-called electric baths." S. HALLETT. Dated April 15.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

3565. "Plates or electrodes for secondary or storage batteries, &c." R. CUNNINGHAM. Dated July 20. 2d. Consists in producing tapes or plates of lead (to form electrodes, for storage batteries), with a roughened or cellular surface on both sides so as to increase the extent of surface to be acted on by the electrolyte. *(Void by reason of the Patentee having neglected to file a Specification in pursuance of the conditions of the Letters Patent.)*

3815. "Supports for telephone wires." J. C. MEWBURN. (Communicated from abroad by O. N. André, of France). Dated Aug. 4. 2d. The improved supports are composed of a straight or bent rod formed with a double cone and screw threaded at the one end to receive the porcelain or other insulator and at the other end to receive a nut. *(Provisional only.)*

3827. "Electric lamps or lighting apparatus." W. R. LAKE. (Communicated from abroad by La Societé F. Gerard et Cie, of Paris). Dated Aug. 4. 2d. Relates to electric lamps or lighting apparatus of that class in which an electro-magnet excited by a current through a shunt or derived circuit is employed for causing the approximation of the carbons. *(Provisional only.)*

3839. "Compounds for electric wire insulators, pipes, &c." W. P. THOMPSON. (A communication from J. F. Martin, of America.) Dated Aug. 7. 4d. The invention consists essentially in a compound consisting of a base composed of asphaltum and marble dust, to which if preferred, other materials such for example as shellac can be added, or which can be used without the addition of such material or materials with highly advantageous results.

3842. "Apparatus for circuit closers and connections for electric alarms." H. W. FERRIS. Dated Aug. 7. 6d. Relates to mats, rugs, and other articles in which an apparatus is fixed for giving notice of the tread of any persons on such mats, rugs, or other articles, by the closing of an electric circuit and the consequent ringing of a bell or making some other signal.

3846. "Means and apparatus to be employed in the transmission of the electric current to electric lamps on vessels, &c." A. L. FYFE and L. GOLDBERG. Dated Aug. 7. 8d. The object of the invention is to produce a complete arrangement on one vessel or barge for the temporary lighting up of ships during their passage through rivers, canals, or other waterways, or during lading, discharging, or other operations where the electric current was heretofore impracticable or unavailable; or for the illumination of harbours, waterways, buildings or warehouses, by a floating electric lighting station or otherwise, by the means hereafter described. It consists in arranging in a flat bottomed or other barge the boilers and engine for the production of the power necessary to drive the dynamo or dynamos to generate the electric current, such motive power in some cases being employed for the propulsion of the vessel, which vessel would be propelled advantageously by a separate engine when required, or it may be tugged. At a short distance from the dynamo on the deck or other convenient place are attached two reels, one for the positive wire, and one for the negative or return wire, to compensate for the varying space between the said barge and the vessel. These reels, around which the leads are wound, have on one side or other convenient part, a device such as a weight or spring, which will maintain approximately the same tension on the wire or wires passing ahead, and on the return wire or wires from the ship to be lighted, and at the same time allowing for the vessel's going suddenly ahead.

3847. "Electrical Signalling and fire-extinguishing apparatus." W. R. LAKE. (Communicated from abroad by S. Ziembinski, M. Szwambaum, and H. Stypulkowski, of Russia.) Dated Aug. 7. 4d. The object of the said invention is to provide apparatus which, being mounted inside a building, in case of a fire breaking out therein, causes alarm signals to be given at any desired place, and at the same time automatically opens a water cock, hydrant, water-valve or the like, whereby water is allowed to flow from perforated tubes or other suitable apertures upon the flame and cause the extinguishing of the same. *(Provisional only.)*

3883. "Construction of incandescent lamps, &c." T. T. SMITH. Dated Aug. 10. 10d. The object of the present invention is mainly to provide increased facilities for lighting the interiors of houses and other structures by incandescent electrical lamps, but the improvements are in part applicable to other systems of electric lighting.

3886. "Storage or secondary batteries." A. J. JARMAN. Dated Aug. 10. 6d. The inventor uses plates of ordinary commercial sheet lead, or they may be made of silver lead alloy, this alloy being an admixture of lead and silver in suitable proportions, to increase the conductivity of the plates, and lower the internal resistance of the cell to any desired extent. These lead or silver alloy plates are bent into a cylindrical shape, (or they can be made rectangular if desired) one cylinder being shaped so as to coat the inside of the stoneware cell, or trough, the other cylinder occupying a central position in the jar or trough; or they can be made into a series of concentric cylinders, and joined up as desired. Between the cylinders, or plates, is packed a sufficient quantity of a special preparation of lead, or lead alloy, or amorphous alloy, made as follows. Commercial lead, or the alloy of silver and lead is poured when red hot into a solution of heated alcohol and water; this produces a granular, or semi-granular metal.

3901. "Construction of electric switch, or apparatus for making and breaking contacts." J. LEA. Dated Aug. 11. 6d. Relates to improvements in electric switches or contact breakers for making and breaking the circuit of electric currents, whereby a perfect contact and break are ensured, as well as greater cleanliness of the various parts. The wearing parts of the switch are made removable to ensure greater durability than in the case of other switches in use.

3910. "Manufacture of incandescent electric lamps." A. SWAN. Dated August 13. 6d. The object of the invention is to simplify and expedite the manufacture of incandescent electric lamps. It has hitherto been the custom in making incandescent electric lamps to connect together the conducting wires to which the carbon filament is attached by embedding them for a certain distance in a round or flattened rod of glass enamel, or other insulating material, or by forming a bar (narrow or broad, as the case may be) of glass enamel, or other insulating material, which thus holds the wires firmly together and at the required distance apart. When the conducting wires with carbon filament attached have been fitted into the bulb or glass envelope of the lamp, this glass rod or connecting bar (as the case may be) ceases to have any practical utility, its value being merely to keep the conducting wires firm and united during the processes attending the attachment of the filament to the conducting wires, and to prevent any strain upon the carbon filament after it is attached to the conducting wires, and until it is fixed firmly in the bulb, such as would be the case if the conducting wires were drawn far apart or pressed close together. According to the invention the inventor substitutes for the connecting rod or bar of insulating material a temporary and movable appliance for connecting the wires together, which appliance (made of insulating material) connects and holds the wires rigid during all operations, until they are attached firmly to the glass, or other material, of which the envelope of the lamp is made, or it can be made, of insulating material, and employed only at such times as it is necessary to handle the wires, or the wires with the carbon filament attached.

3946. "Apparatus for generating and utilising electric currents." PAGET HIGGS. Dated Aug. 14. 4d. One part of the said invention comprises improvements in the main frame of the machine and consists essentially in the novel arrangement of the various parts of the main frame whereby the cost of its construction is considerably reduced. Another part of the said invention comprises improvements in the construction of the armature, and consists partly in arranging two rings side by side in such a manner, that the currents which are induced in the said rings by the poles of the field-magnet are strengthened by the inductive action which takes place between the rings as hereinafter described. This part of the invention also includes a novel method of solidly fastening the said armature rings to the hub which carries them. It also comprises improvements in the construction of armature rings of the well known "Pacinotti" or "Gramme" type or form, whereby air is allowed to circulate freely through and against the inner side of the iron of the same in order to keep the ring cool. *(Void by reason of the Patentee having neglected to file a Specification in pursuance of the conditions of the Letters Patent.)*

3967. "Insulating supports for telegraph and telephone wires." S. WOOLF. Dated Aug. 15. 6d. Consists in the construction of an earthenware sheath with supporting arms, projections or brackets also of earthenware to carry the wires either moulded in one therewith or made separate and attached thereto by bolts or otherwise.

CORRESPONDENCE.

A Protest.

A few days ago, I happened to read the last issue of the Society of Telegraph Engineers Journal, No. 51, when I was greatly surprised by finding in its contents a certain "original communication," which had been allowed to find its way through the editing committee into the said journal. Doubtless many of your readers, who are also members of the above society, are perfectly aware that the present publication of the above journal, or even for these last three or four years, has lost a great deal of its "standard compilation" as regards general information on electrical science, as well as in originality and importance of subjects in general, brought before the society at its meetings; and this can be easily verified by examining a few of the older volumes.

It is not surprising to see several of its most influential and distinguished members bringing interesting papers before the Society of Arts, the Physical Society, or other scientific bodies, before presenting them to the above society; the reason of this is, of course, self explanatory.

But if there is a lack of important matter to fill the pages of the said journal, Professor Ayrton (the chairman of the editing committee) has always been very attentive to supply us with several pages about his "dead beat needles" mounted in thick and thin wire coils, "highly" classified by a score of names: or by descriptions of his "highly efficient" motors and other similar *appareil*, of which a great deal too much can be learned from his daily advertisements. Of course useful papers have in the mean time been rejected, simply on the ground that they did not emanate from the right source or because they were not highly polished enough.

On a former occasion you made similar remarks in your Review* relating to a number of the journal of the society, in which a third of its space was occupied by an "irrevelant" but highly advertising paper on "Clocks Synchronisation," read before the society by Mr. Lund. As my chief object is to call the attention to the last issue, I shall confine myself to that so called "original communication" at page 113, "on the direction assumed by a magnet within a solenoid or hollow magnet," kindly supplied by S. M. Banker.

Mr. B. begins by informing us that on a recent occasion, whilst preparing a "short" description (indeed it would require a special creative mind to make it a long one) of what is called by telegraph linemen the "detector" (let us hope that the difficulties encountered in its description have not paralysed his efforts!) when he discovered "an effect" which, he informs us, has been hitherto overlooked. After explaining how a magnetic needle is deflected in a coil of wire, he sums up and says:—"The fact appears to have been hitherto overlooked that a current passing through a bobbin of wire has a twofold action":—

1st. The action on the magnetic needle.

2nd. The polar action of the bobbin.

He then proceeds to say that a needle placed within a coil follows a different law, which he calls "masked," which must of course lead his readers to the conclusion that his elementary knowledge on electro-magnetism is masked in its stead!

How such a ridiculous communication could have found a place in that reputed journal I am at a loss to say, but one thing may be said and that is, without saying anything in regard to certain advertisements in disguise, that by such publications the editing committee can hardly expect to increase the value of the journal, nor their reputation.

Currente Calamo.

Secondary Generators.

In his report on the tests made on the Gaulard and Gibbs secondary generators, Dr. Hopkinson says:—"During a portion of the time the Jablochkoff candles were extinguished, in order to enable me to determine the efficiency of the part devoted to incandescent lights." It would be interesting to know if the secondary circuit was simply broken in this case, or whether the generators supplying the Jablochkoff candles were cut out altogether, because it was conclusively shown by Mr. Rankin Kennedy, in a letter to the REVIEW about a year ago, that there is less energy used in the primary circuit when the secondary circuit is closed than when the latter is open. This fact can be proved both magnetically and electrically on the principle of reaction. Whatever the results of the above system, there can be no doubt that much better results will be obtained in the future when secondary generators are constructed in suitable proportions to facilitate rapid magnetic change, and when supplied by a suitable dynamo.

To get the maximum inductive effect from secondary generators, the magnetic reversals should not exceed 8,000 a minute, because magnetism in iron requires time to alter its state. The dynamo at Edgware Road probably gave from 16,000 to 20,000 alternations a minute. The artificial resistance set up in the primary circuit of the generators by this *hurrying* of magnetic change must have been something enormous. The effect produced would be analogous to that in the old alternating dynamos, having iron armature cores, when rotated beyond their proper speed.

E. L. Voice.

1, Francis Street, W.C.,
April 12th, 1884.

Private Wires.

Could you, or any of your readers, kindly inform me whether a private person is at liberty to erect a telegraph line between two houses (for experimental purposes only), without first obtaining the sanction of the Postmaster-General.

Phosphor Bronze.

[It is not necessary to obtain the permission of the Postmaster-General.—EDS. ELEC. REV.]

Electrical Patents.

It must be matter of common observation to any person who attentively watches passing events in the scientific world, that there are epochs or periods of time when an impetus is given to invention in some particular line, so that the ingenuity of a great many minds is concentrated on one subject, and a large number of patents are taken out for improvements in connection with it. Such an epoch was that which marked the invention of roller skates, and again that which heralded the introduction of bicycles, and more recently those which marked the invention of the telephone and the development of the electric light.

During the last six or seven years, since the publication of the telephone and the practical application of electricity to illuminating purposes, a phalanx of minds has been teeming forth invention after invention in such rapid succession as to call forth expressions of astonishment at the almost boundless range of the inventive faculties when once they are directed to the accomplishment of any special object. For, this stream of invention has not been confined to the subject of the telephone and the electric light, but has extended itself to the various branches of electrical science, so that from its ramifications we have had improvements in dynamo-electric machines, magnets, induction coils, electro-motors and locomotion, electrolytic cells, and electrical apparatus of almost every other description. The subject has indeed been a prolific one, as the archives of the patent office plainly show; but notwithstanding the best of patents that have been taken out, it is greatly to be questioned whether one fifth of the number would stand the ordeal of litigation. This crucial test of judicial scrutiny, if applied to existing patents on electrical subjects, would most probably result in the failure of four-fifths of the whole number to come up to the required standard.

* See ELECTRICAL REVIEW, Vol. X. page 175.

But it may be asked, What are the causes of the invalidity of so large a majority of the patents which are constantly being taken out for alleged improvements in electrical apparatus? We might name several, such as defects in the specifications, either in the way of inaccuracy or insufficiency of description or impropriety in the claims, or an unknown prior publication, or use of the things patented; but probably the principal reason why so many patents are taken out which are intrinsically worthless is because inventors generally have such very erroneous ideas on the subject of what constitutes a patentable invention.

Persons think that the most obvious suggestion is patentable if it has never been done "before." It occurs to one that it would be convenient to put a telephonic transmitter and receiver together into one small case provided with mouth and ear pieces, and he takes out a patent for it! Another thinks it would be desirable to use in the receiver bifurcated flexible tubes, carrying ear pieces one for each ear, and patents *that!* Again A discovers a method of effecting a given object with the aid of a permanent magnet, and patents it. B seeing that A has not included in his specification the use of an electro-magnet as an alternative, patents it; and C perceiving that neither A nor B has described that a solenoid or sucking magnet may be employed for the same purpose, patents *that;* B and C overlooking the fact that the use of a certain device for a given purpose being known, a valid patent cannot be obtained for the use of the known equivalent of such device for the same purpose where no additional invention is involved in the application of the equivalent. It follows, therefore, in the majority of cases, that A's patent is confined to the use of the permanent magnet, as from want of foresight he has omitted to include its equivalents in his specification, and B's and C's patents are bad, whilst the public are entitled to use their contents, which A had he been properly advised, would have included in his own patent.

Of course the doctrine of "equivalents" must not be pressed too far, as, there being "nothing new under the sun," it would be possible to trace an analogy to something previously known in the most novel invention which has ever seen the light, but without any such far-fetched or strained application of the doctrine, there is no doubt that inventors, as a rule, are too prone to jump to the conclusion that the most obvious expedient or equivalent may be patented if the identical thing has not been actually used or published; notwithstanding that something, which is the same to all intents and purposes, having the same object and accomplishing the same result by substantially the same means, is well known and possibly largely adopted, a mistake which is frequently only discovered after the patentee has committed himself to a large outlay and sunk a considerable sum of money in a worthless enterprise.

T. J. Handford.

Electricity in Collieries.

The report (taken from *Engineering*) of the discussion which took place upon Mr. Brain's paper at the recent meeting of the South Wales Institute of Engineers appears somewhat "mixed."

The paper contained a description of electrical plant which Mr. Brain laid down two years ago for working a pump in a difficult part of the Trafalgar collieries, about 500 yards from the surface, the power being transmitted by means of an electric current furnished by a generator on the surface, and working a motor in the neighbourhood of the pump.

In the course of the discussion, I suggested that similar arrangements would be useful in exploring mines after an explosion. I understood that after the recent explosion at Pen-y-Craig Colliery, Mr. Daniel Thomas, and the others who perished with him, were lost through their having gone, in their efforts to reach the workers in the mines, out of the air current. They had got into a portion of the mine where, owing to the damage caused by the explosion, the fresh current of air that was still circulating in other parts of the mine did not penetrate.

It occurred to me that if light fans could be placed in different parts of the mine the current of air might have been directed to all parts, so that the work of exploration could have been safely carried out. I suggested, therefore, that these fans might be worked by electro-motors, driven by a current or currents furnished by one or more generators on the surface.

On those occasions time is of the very utmost importance; a few minutes lost or gained in the finding of a body underground may mean the difference between life and death. Such an arrangement, with the number of willing hands that are always available on such occasions, could be carried out very quickly indeed, since all that would be required would be to get the thing to go for a certain short time, the most temporary arrangements for fixing would be quite sufficient.

Some of the members feared that my proposal was not feasible, on account of the sparking at the commutator of the motor, and the possibility of the wires being broken; the last portion there would, of course, be very little difficulty in overcoming. Wires used for electric lighting are not readily broken, and it would be quite easy, without taking up much time, to place them in such positions that they would practically be out of danger.

The case of the sparking at the commutator is more serious; but I expressed the opinion, to which I adhere, that it would not ignite gas; and for the reason that I have tried to ignite a stream of coal gas pouring freely over the commutator of an "E" Gramme machine, which was furnishing three arc lights at the time. Though the gas ignited readily with a lighted taper or match, my utmost efforts failed to get any ignition from the spark at the commutator.

To make certain, however, I suggested that the matter should be tried by placing an electro-motor in a closed chamber filled with gas, and allowing a current to pass into it.

The trial above referred to to ignite gas was made two years ago, and since that time very great improvements have been made in this particular part of the apparatus: so far, that Professor Silvanus Thompson, in his recent paper read before the Society or Arts, mentions the fact that with some of the late dynamos constructed with compound-wound field-magnets, there was practically no sparking at the commutator; you could not tell, from looking at the commutator, whether the machine was furnishing current or not, a result that agrees with my own observation of the Gramme compound-wound dynamos. Supposing, however, that even this should prove enough to be dangerous, I submit that we are by no means at the end of our resources. Sparking is very much less, even in the now old type of machines, than it was in the still older machines, and it can be made still less by continuing in the same line.

Remembering, however, the smallness of the spark of our latest dynamos, the great speed at which the armature revolves causes by itself a continuous current of air around it, so that it would be difficult for gas to be present in the position favourable for igniting. I still believe it will be found that there is practically no danger in using electro-motors in fiery mines.

While on the subject, it almost naturally occurs to one that exploring parties on these occasions might carry a telephone with them, a very small wire coiled on a reel that could be easily carried, the other end being connected to an apparatus on the surface, would enable them to maintain constant communication with their friends above. As the matter is of considerable importance, I have ventured to correct the report, in the hope that others interested in the matter may take it up.

Sydney Ferris Walker.

195, Severn Road, Cardiff.
April 7th, 1884.